SOEN 6481 - Systems Requirement Specification

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Requirement Analysis for a Nursing Decision Support System

Project Report

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1. Introduction

This document outlines the vision for the Clinical Decision Support System for nurses.

1.1 Purpose

The purpose of this document is to collect, analyse, and define high-level needs and features of the Clinical Decision Support System. It focuses on the capabilities needed by the stakeholders, and the target users, and why these needs exist. The details of how the Clinical Decision Support System fulfills these needs are described graphically and in detail in terms of use-cases and supplementary specifications.

1.2 Scope

This Vision Document applies to the Clinical Decision Support System (CDSS), which will be used to build the system by the development team. The development team will build this system to provide a computerized aid to nurses with focus on wound-care management. The CDSS will provide information to aid in diagnosis of wound conditions and about wound care products, alerts and reminders regarding the patient's condition, accurate diagnosis and prescriptions in a small amount of time along with a multitude of features which aids nurses and improves their efficiency while working in the hospital.

2. Positioning

2.1 Problem Statement

The problem of	absence of a computerized decision support system for wound-care management.
Affects	nurses, doctors, patients and hospital staff
The impact of which is	uncertainty in devising an accurate diagnosis and also taking a longer time which results in putting the health of the patient in jeopardy.
A successful solution would be	a clinical decision support system for wound care

	management that is designed to support nurses in performing their day-to-day wound-care tasks thereby improving their efficiency and bringing improvement in the treatment of patients. The product would provide an accurate diagnosis to nurses reducing the need to contact superiors which results in reduced treatment time of patients. In addition, the system would provide an option to store and retrieve old patient records, monitor patient status, issue alerts and reminders and the ability to retrieve details on different kinds of wounds and wound-care products.

2.2 Product Position Statement

For	Nurses(primary end-users), doctors and hospital staff
Who	Feel the need of a computerized system to ease their day-to-day work in the hospital and improve patient treatment.
The Clinical Decision Support System (CDSS)	Is a software product which works as a web application in a browser on the hospital's network.
That	Provides an accurate diagnosis for the specified wound in a small amount of time resulting in reduced workload for nurses and also provides a medium to store patient records.
Unlike	Using judgment to treat a wound, or waiting for a superior or a nurse with more experience for advice, resulting in improper treatment of a patient and causing problems to the hospital and using papers and hard copies for brochures to store patient record.
Our product	Provides diagnosis for wounds and displays a lists a set of treatment plans which are prioritized based on past successful patient records and the treatment plans that worked for them. The system also provides a log for storing patient information. This

	makes it easier to review information on an existing patient later. In addition, the system provides multiple functionalities such as data and image interpretation of x-rays and different scans, issuing alerts and reminders regarding patient status, information on the products being used such as the medications and the dressing agents in the treatment of different wounds and a search tool for nurses to find additional info and past occurrences of specific wounds.

3. Stakeholder and User Descriptions

The stakeholders and users are divided into two categories –

- **Non-User Stakeholders**

  Some stakeholders are only indirect users of the system or are affected only by the business outcomes that the system influences. These stakeholders tend to be found elsewhere within the business, or in "the surrounds" of the particular application environment. In yet other cases, these stakeholders are even further removed from the application environment.

- **User Stakeholders**

  The users who are directly involved in the usage of the system are the user stakeholders.

3.1 Market Demographics

The product being developed is intended for the healthcare industry. It is to be used in hospitals only. The users are anticipated to be nurses who have basic computer skills. The system is made with respect to the requirements of the nurses in wound-care management. It will not be of much use to nurses who do not specialize in this field. Although, any hospital personnel can look up patient information provided he is a registered user and is authorized to access the data. This system can also be used in clinics which specialize in wound-care management although it would not be of much use in a clinic handled by a few personnel.

3.2 Stakeholder Summary

The descriptions and responsibility of each of the stakeholders involved in the project can be summarized as follows.

3.2.1 Non-User Stakeholders

Name	Description	Responsibilities
System Analyst	This is a stakeholder that works with the other stakeholders to gather their needs.	Leads and coordinates requirements elicitation and use-case modeling by outlining the system's functionality and delimiting the system; for example, identifying what actors exist and what use cases they will require when interacting with the system.
Requirements Specifier	This is a stakeholder that works with the Analysts to correctly translate requests/needs into requirements to be used for design.	Specifies the details of one or more a parts of the system's functionality by describing one or the aspects of the requirements, this will include functional and non-functional.
Technical Reviewer	This is a stakeholder that must be involved regularly to maintain the development cycle.	Responsible for contributing feedback to the review process. This role is involved in the category of review that deals with the technical review of project artifacts. This role is responsible for providing timely, appropriate feedback on the project artifacts being reviewed.
Software Architect	This is a stakeholder that is primary for leading the system development.	Responsible for the software architecture, which includes the key technical decisions that constrain the overall design and implementation for the project. Ensures that the system is going

Name	Description	Responsibilities
		to be maintainable and the architectural solution supports the functional and non-requirements.
Project Manager	This is a stakeholder that is primary for leading the system development.	Plans, manages and allocates resources, shapes priorities, coordinates interactions with customers and users, and keeps the project team focused. Also establishes a set of practices that ensure the integrity and quality of project artifacts.
Market Analyst	This is a stakeholder that will assist our abilities to position our product successfully.	Ensures that there is going to be a market demand for the product's features and for the new service.

3.2.2 User Stakeholders

Name	Description	Responsibilities
Wound Nurse	Primary end user of the system	Using the system for treating patients who have both acute and chronic wounds, including burns, pressure ulcers and surgical incisions that have not healed, monitoring patient status, keeping record of patient's information.
Doctor	End user of the system	Taking patient's medical history, performing the wound examination, making medical diagnosis, prescribing appropriate

		medicine, monitoring patient's response to those medicine.
Medical Data Entry Specialist	End user of the system	Assisting in entering orders for medications and lab tests, and assisting in patient information data entry.
Hospital Administration	End user of the system	Planning, coordinating and overseeing the effective and efficient delivery of wound care management system, also budgeting, scheduling, information management, marketing, internal communication etc.

3.3 User Environment

The system is installed on a computer that is running Windows operating system. The system is a web-app and is to be used in a browser. The nurse can access the system only locally. Remote access is not possible.

3.4 User Stakeholder Profiles

The detailed description of the user stakeholders is described in this section.

3.4.1 Wound Nurse

Description	An individual who will use the system for performing their day-to-day wound-care tasks.
Type	Primary User, mainly specializing in wound-care management.
Responsibilities	Provide appropriate treatment to the patients who need assistance with

	their wounds by applying the appropriate treatment plan suggested by the system.
Success Criteria	Success for nurses is defined by the ability to provide assistance and comfort to the patient by providing the accurate treatment plan with the help of the system in the smallest amount of time possible without the need to consult with others.
Involvement	The system is designed with respect to needs of a nurse, therefore the involvement of the nurses during the testing and the deployment phase is crucial for the success of the product.

3.4.2 Doctor

Description	An experienced individual in the healthcare industry who will use the system rarely.
Type	This is a casual user, possibly with previous use of clinical decision support systems.
Responsibilities	Ensure that there is necessary information to make a clear and accurate decision for wound care management.
Success Criteria	The success is completely defined by the users continuing to make decisions and motivate nurses to use the system for wound care management.
Involvement	The doctors will help in formulating new treatment plans whenever available. Involvement of doctors is very less.

3.4.3 Medical Data Entry Specialist

Description	An individual responsible for managing and monitoring system and entering data into the system (on the software).
Type	This is a heavy user, who continuously monitors and updates patient records on the system.

Responsibilities	Updates patient records on request of the nurses and makes sure that pending patient tasks are taken care of. Assisting in entering orders for medications and lab tests, and assisting in patient information data entry. He is also responsible for reporting errors and bugs in the system to the developers.
Success Criteria	The success is completely defined by continuous running of the system with the ability to store and retrieve correct patient information from the database.
Involvement	The moderators provide constant feedback of the system to customer to support, such that he bugs can be fixed in the next update.

3.4.4 Hospital Administration

Description	An individual or a group of individuals who are responsible for maintaining the system.
Type	This is a casual user, possibly with previous use of clinical decision support systems.
Responsibilities	Ensure that the system is up-to-date and contact customer service in case of failure or downtime of the system.
Success Criteria	The success is completely defined by continuous running of the system with least number of complaints being received by the users and minimal failures and downtimes.
Involvement	Hospital administration is continuously involved in the maintenance and the constant improvement of the system. They ensure that the databases are updated frequently and make sure the systems and databases do not suffer any failure.

3.5 Key Stakeholder and User Needs

Need	Priority	Concerns	Current Solution	Proposed Solutions
Issuing Alerts and Reminders	High	Ability to understand patient status	None	Every patient record should have an option for monitoring live status.

				Ability to change and update patient condition as and when required.
Comfortable User Interface	Low	Nurses require training to adapt to the system.	None	The UI should be simple and easy to understand.
Diagnostic Assistance	High	Provision of accurate real time treatment plans	None	A system that generates a list of treatment plans upon entering patient data.
Data and Image Interpretation	Moderate	Incorrect interpretation of x-rays and other scans.	None	A system that compares scans for abnormalities for human attention.
Data Entry Assistance	High	None	None	Assistance for entering orders for medication and tests, patient data entry.
Therapy Critiquing	Low	System provides incorrect diagnosis.	None	Ability to find flaws and negative effects in the proposed treatment plans.
Prescription and formulating treatment plan	High	Side effects of prescribed drugs and formulating incorrect treatment plans.	None	Suggestions provided for the prescribed drugs in the treatment plan with notifications of possible allergy clashes to formulate an accurate treatment plan for the patient.
Information Retrieval	High	None	None	Filtering relevant documents from a search engine or databases that provides additional

				information on requested queries and carry out personalized searches.

3.6 Alternatives and Competition

This system is specific to wound management and is designed to cater to nurses. The Clinical Decision support system is mainly going to be used to aid in diagnosis and treatment plans for wounds only. There is no CDSS in the market that is specific to wound management. There is a possibility of this system being integrated with existing CDSS which provide functionalities other than wound-care management.

4. Product Overview

This section will give an overview of the whole system. The system will be explained in its context to show how the system interacts with other systems and introduce the basic functionality of it. The product perspective will be described in detail with a block diagram that will help in the better understanding if the system.

4.1 Product Perspective

The system being designed is Clinical Decision Support System (CDSS) which is being built is mainly going to be used for wound therapy. The main users are going to be nurses. The system will provide information to aid in providing diagnoses for different wound conditions and give a description about wound care products, provide alerts and reminders regarding the patient's condition, accurate diagnosis and prescriptions in a small amount of time along with a multitude of features which aids nurses and improves their efficiency while working in the hospital.

The nurses and doctors have a unique user ID and passwords that is authenticated to gain access to the system and utilize the system features. There is a forgot password option to request password recovery. The password is sent by the system back to the pager. The other user is a medical data entry specialist that is responsible for updating patient records on request of the nurses and makes sure that pending patient tasks are taken care of. Although the main responsibility

of the medical data entry specialist is in assisting in entering orders for medications and lab tests, and assisting in patient information data entry.

The next screen will have four options namely New Patient, Existing Patient, Diagnostic Assistance and a search bar for retrieving queries.

Upon clicking the New Patient button, the system navigates to the screen which displays the mandatory form that needs to be filled which consists of the patient details. These forms help in analysing patient details and displaying a list of treatment plans based on the wound details and the symptoms that have been filled in the form. This screen provides an option for saving details, providing diagnostic assistance and an option for uploading scans and x-rays of patients to look at abnormalities of the patients. Upon clicking the diagnose button, the system looks at the patient data and generates an appropriate treatment plan to treat the wound. There is also an option to set alerts and reminders to monitor patient status.

The Existing patient option displays a comprehensive guide that describes every detail about the wound, its characteristics, the treatment plans, the observed symptoms, dietary advices, etc. The modify option is used to edit and add new info about the patient into the system. A diagnostic assistance can also be performed from here.

The Search bar helps in retrieving information by retrieving data from a search engine or from the database based on the user queries entered.

The last option is the Quick Diagnostic assistance that gives a form that requires the nurse to enter the specifications and details of the wound to generate an appropriate treatment plan. Since this is a data-centric product it will need some place to store the data. For that, a database will be used. The database will be centralized and the local systems will be connected to the database using the hospital's Local Area Network. The data will be stored in multiple tables for easy differentiation and retrieval of data. One table will store the patient data, the second will store the wound catalogue and the third will contain the database of the treatment plans.

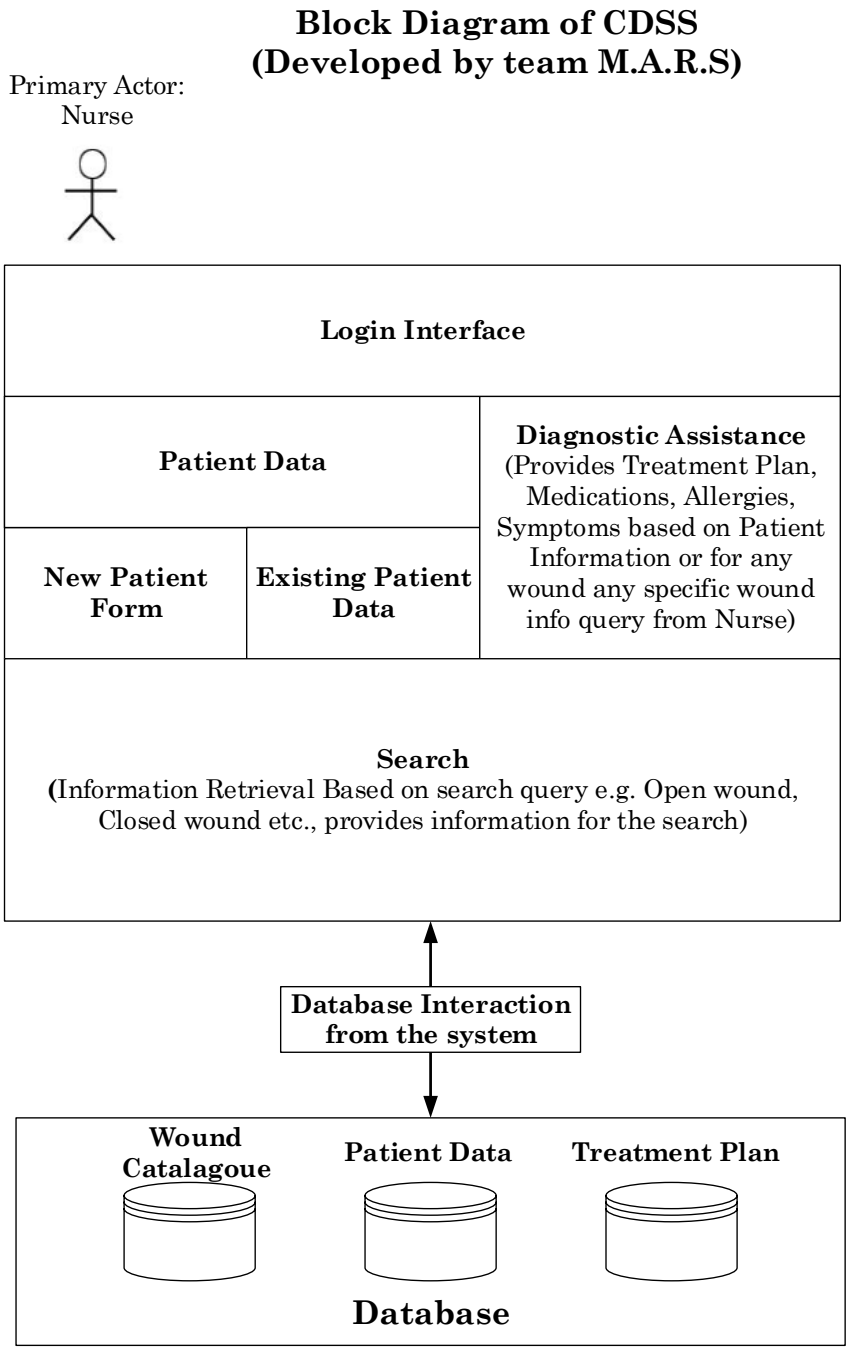

Figure 1: Overview of the CDSS Architecture

4.2 Summary of Capabilities

Customer Benefits	Supporting Features
Convenient, flexible, easy and reliable access to the system	The user can access the system on a personal computer on which it is installed. The user simply needs to enter their username and password to gain access to the system. There is an option to retrieve forgotten password too.
Secured access to the system	The user can login only with proper authentication. The user name and password should match.
View diagnoses, treatment plans and other data relating to wounds. (Information Retrieval)	The user can view past patient history, occurrence of wounds and treatment policies applied to each wound systematically by entering accurate queries in the search field provided in the main screen of the system. **Provision of a Wound Catalogue** The system provides a comprehensive reference for the different types of wound along with the pictorial descriptions and images. The catalogue shall provide the following features – • *Pop-up definitions for expert terminology*: a small frame on the corner of pages, a static location, in which information about major keywords appears when the mouse hovers over those keywords • *Search Box*: A search functionality that allows the user to enter queries and the facility to search data in help pages using basic or advanced search techniques.
Create Patient Data	**Adding New Patient Details** The system provides a form that needs to be filled. The nurse or moderator is responsible for filling out the form which consists of all the necessary details for admittance and performing treatment, just like the normal paper patient form. This is a routine procedure and needs to be followed for every patient.

	There is provision for adding images such as scans and x-rays to determine a good treatment plan for the patient. These images are going to be checked for potential abnormalities for human attention. **Braden Scale** The scale is used to check the risk of a patient to develop a pressure ulcer. The system has a provision of the nurse and helps the nurses to monitor the patient's risk of monitoring a patient request. The Braden scale and reference for assigning conditions to possible descriptions. Pop-up notes can be used in the same manner as suggested for the wound catalogue mentioned above.
View Existing Patient Details	After saving, the form gets stored in the Patient Database. While saving each patient is designated a unique patient ID. The patient details can be viewed by entering either this or the ID. Upon entering a few letters, the system displays a list of names that already exist in the database to make it easier for the user to identify the user. There is provision for modifying data. Both the nurse and the moderator have the power to modify and view data. The moderator would require authorization from the designated nurse to modify and save patient details into the database. **Patient's Complete Record** The patient's complete record can be viewed including the reasons for hospitalization and other details such as allergies, preferences, etc.

	Patient Brochure The Patient's Brochure holds the entire patient data. It provides the user a comprehensive guide that describes every detail about the wound, its characteristics, the treatment plans, the observed symptoms, dietary advices, etc.
Data Entry Assistance	The system will provide numerous ways to enter information into the database. They are listed as follows – • *Wound specifications:* location, type, and size of the wound, along with other specifications (e.g. granulation, swelling, exudates, etc.), a wound chart, a remark column to indicate type of wound and possible complications such as infection or swelling. • Patient's Braden score and his/her risk for developing a pressure ulcer. • Expert recommendations such as the wound nurse, the dermatologist, the podiatrist, and the nutritionist's recommendations on the type of dressing and/or patient's diet. • Nurse's decision to check patient once again before discharge? • *Doctor's recommendations*: doctor's preferences for dressing/cleansing agent if any. • *Patient's preferences*: whether patient wants to be visited by the wound nurse although the doctor doesn't think it's necessary, whether the patient wants his stitches removed by the wound nurse, etc. • Patient's behaviour: Whether the patient is hard to deal with, meddles with dressing, etc. for disclosure with his family/caregiver.

Provide preferential diagnosis	The most important feature of the system is to provide a diagnosis for the wound in question. The system ranks the treatment plans with the rate of success of similar conditions of patients treated in the past with that treatment plan. These treatment plans are generated by reviewing the details entered by the nurse in the screen where the properties of the wound are submitted. Each treatment plan provides three important details which are critical for the nurse to decide on the treatment plan. The features are – medical prescription, suggested dressing and observations. Additional details such as risks involved are also displayed.
Speed and Accuracy	The system should devise a treatment plan in a matter of seconds. The treatment plan generated is accurate and concise.
Issuing Alerts and reminders about patients	Every nurse in the institute is assigned a private pager which forms an integral part of communication between the nurse and the system. The system is designed to alert nurses in change of patient conditions and time to review and monitor patient status. The system will issue prompts and warnings for the following situations – • Complicated wound or wound getting worse: system should prompt the nurse to refer to a wound nurse. • The dressing agent being using not be suitable for the wound: system warns the nurse for safety. • The nurse starts using a different dressing agent without a doctor or wound nurse's recommendation: system warns the nurse. • Doctor/wound nurse/patient a dressing agent different from the one the nurse is using: system warns the nurse.

	The system will issue alarms in the following states – • Change of dressing due date • Turning chart and patient repositioning due time • Patient's allergies • STO due date
Scalable	The system is capable of handling a large volume of data and a large number of users.

4.3 Assumptions and Dependencies

This system is designed to run on Windows Operating Systems. The versions of the operating system may change later with respect to the versions installed in every hospital. The recommended Operating system would be Windows 7. Development on other operating systems is not necessary. There has to be a major overhaul if that happens. The chance of this happening is very less as usually Windows 7 is the preferred operating systems in most healthcare organizations.

4.4 Cost and Pricing

The estimated cost of building the system and the price will be decided later in upcoming build meetings.

5. Product Features

This section showcases the comprehensive list of features of the system. The features include the functional and non-functional requirements of the system.

The following are the login related features of the system -

- Login option for doctors and nurses.
- Login option for medical data entry specialist.
- Forget password option for doctors and nurses so that if they forget their password they can retrieve their password back to their pager after verifying their identities.
- A Help button which can give answers of frequently asked questions.

The following features relate to entering new patient information into the database -

- Create new patient record.
- Generate unique patient id for each new patient.
- Checking mandatory fields of the form and give errors if the form is not filled properly.
- Refresh the patient form.
- Saves patient data in the hospital database.
- Generate pdf of patient details.
- Print the patient details.
- Creates alerts or reminders about patients.
- Sends alerts or reminders to the responsible nurse to their pager.
- Logout option for doctors and nurses.
- Automatic logout option for doctors and nurses after 20 minutes of inactivity.
- A Help button which will assist how to fill up the patient form.
- Patient form fill up suggestions when filling up the form.
- Shows the present time and email notifications for the user.

The following are the features that the system provides for viewing and editing existing patient data -

- Checking existing patient details.
- Ability to upload reports like scan reports etc.
- Edit patient data.
- Delete patient data.
- View patient status.
- View duration of treatment.
- Saves patient data in the hospital database.
- Generate pdf of patient details.
- Print the patient details.
- Creates alerts and reminders about patients.
- Sends alerts or reminders to the responsible nurse to pager.
- Logout option for doctors and nurses.
- Automatic logout option for doctors and nurses after 30 minutes of inactivity.
- A Help button which will assist how to fill up the patient form.
- Patient form fill up suggestions when filling up the form.
- Shows the present time and email notifications for the user.

The following features that relate to quick diagnostic assistance -

- A form which will ask information about wound, wound type, contamination, symptoms about the patient.
- Compares entered patient data with previous data available in hospital database.
- Generate set of treatment plans for patients based on the data available and prioritize according to previous success rate.
- Saves the patient's wound information and prescribed treatment plan in hospital database.
- Generate pdf for the treatment plan of the patient.
- Print the treatment plan of the patient.

- Logout option for doctors and nurses.
- Automatic logout option for doctors and nurses after 30 minutes of inactivity.
- A Help button which will assist how to fill up the patient's wound information.
- Patient's wound information fill up suggestions when filling up the form. (44)

6. Other Product Requirements

- **Stability**: The proposed system will be stable with any kind of environment.
- **Re-usability**: The design system is build considering the design of Model-view-Controller that will help to reuse the system.
- **Portability**: The system will be able to run in different platforms.
- **Extendibility**: The system can be extended by sub-classed applications.
- **Readability**: The code should be well written and documented, commented, structured accordingly, naming and coding conventions should be persistent.

7. Documentation Requirements

This section shows the different standards and requirements needed to run the system. Some of the requirements are mentioned in detail in the supplementary specifications.

7.1 Applicable Standards

The system should follow the international Organization for Standardization ISO9000 standards to ensure quality management needs and meet the wants of customers and stakeholders. Also it should follow ISO29127: 1988 standard to standardize User Documentation and cover information for consumer software packages. It needs Windows OS to run.

7.2 System Requirements

Refer to the Supplementary Specifications for a comprehensive description on the recommended hardware and software requirements.

7.3 Licensing, Security, and Installation

Initially for the Clinical Decision Support System delivery, the system usage is restricted to the healthcare industry. The feedbacks are collected from the nurses and doctors in order to improve the system for improving and implementing newer features in the system.

7.4 Performance Requirements

The system shall provide real time response to users while they are interacting with it. It shall simulate all the changes occurring to the object.

8. Documentation Requirements

This section shows the various documentations that help the user to understand the system.

8.1 User Manual

- The user manual shall detail the minimum system requirements.
- It shall describe the use of the system.
- It shall list and describe the system's features.
- It shall be available online.

8.2 Online Help

- Online help shall be available 24/7.
- It shall be available for each function with demo.

8.3 Installation Guides, Configuration, and Read Me Files

- Installation guide shall show how to install the system with pictures step by step.
- Read me file shall list new features.
- It also shall list common troubleshooting and workaround.

8.4 Labelling and Packaging

The label of the developers company will be shown on all packaging and documents.

9. Supplementary Specifications

This section list the entire supplementary specifications of the system.

9.1 Introduction

This part of the documentation gives a detailed description of the user requirements that are not captured within the software requirement specifications document. The features include user requirements such as security, reliability, performance, etc. These requirements are listed out in an easy and organized manner to fully define the system-to-be-functionalities. It includes the requirement definitions agreed upon, quality goals, and design constraints. We can find multiple quality goals like performance, reliability, supportability as well as usability. This part of the document can also be used to identify the different design constraints of the system such as performance issues and other factors that will affect the working of the system. In other words, the supplementary requirements can be used to capture the requirements which cannot be elicited in terms of the use case diagrams.

9.1.1 Purpose

The purpose of the Supplementary Document is to define requirements of the Clinical Decision Support System that are not captured in the use cases. This document lists these requirements as a reference for team members to use throughout the software development process.

9.1.2 Scope

This Supplementary Specification applies to the Clinical Decision Support System that is to be used in the healthcare industry. The system is being built with the primary goal of wound management and the main users are going to be the nurses who specialize in wound therapy.

The CDSS will provide information to aid in diagnosis of wound conditions and about wound care products, alerts and reminders regarding the patient's condition, accurate diagnosis and prescriptions in a small amount of time along with a multitude of features which aids nurses and improves their efficiency while working in the hospital.

This specification documents the non-functional requirements of the Soft-body system like performance, usability, and reliability, to name a few. Also, it defines functional requirements defined in the use cases.

9.1.3 Overview

The Supplementary Specifications are elicited here with respect to the system in question which is the "Clinical Decision Support System" in wound care management. The rest of the Supplementary Specification will address the functional requirements of the system that address functionality, usability, reliability, performance, and supportability. Then, the document will address design constraints on the system being built. The Online User Documentation and Help System Requirements will be discussed followed by a list of the interfaces that must be supported by the application. Finally, we will address applicable standards applied on the system and the glossary.

9.2 Functionality

This section lists the support system's functional requirements retrieved from the system's use case models.

9.2.1 Save Patient Data

The user chooses to save the patient data once all the mandatory fields are filled. All the mandatory fields have an asterisk allocated to them. In case the user fails to fill up all the mandatory fields or enters improper information into the fields, the system will prompt the user to re-check and fill the fields that are incorrect or incomplete. The fields in question will be highlighted so that the user will be able to identify where he committed an error so that he can quickly correct it. Once the form is complete, the user clicks the save button. As a consequence, an XML file format is created and saved in the patient database.

There is a field to issue to alerts and reminders to the designated patient which forms a very important feature of the system. The system monitors and keeps track of this field for every single patient and sends a page to the nurse when the time matches with the system clock.

9.2.2 Upload of Scans and Reports

Every patient form has an optional field of uploading scans such as x-rays and MRI's. During upload the system offers an option for type of document. These options become mandatory once the document upload button is clicked. The user needs to click the right option as the system has no way of determining the kind of scan that is being uploaded. The nurse needs to check if they have uploaded the right documents. These scans are compared with previous scans in the database to develop an appropriate treatment plan. These scans can be viewed later upon request in the existing patient form. A scanner is required for this functionality.

9.2.3 Search Engine

This forms a very integral part of the entire system. This is one of the key requirements of the system. A search bar is provided after the nurse logs into the system. An in-built search engine that provides additional information on requested queries in the search bar. The system performs a query and the documents that closely match the query are displayed in the result screen.

9.2.4 Help Option for Users

There is a help option offered to the user which helps in giving additional information on how to get around the system. It's a simple screen that again requests a query from the user. The search then turns to the database that contains all the frequently asked questions and relevant descriptions of the system. This is a very useful feature and helps users to get around the system and use the system with ease.

9.2.5 Forget Password option

This is a straightforward option which offers the user to retrieve the password of the account in case the user forgets his or her login credentials. The system asks a few security questions and sends the password to the nurse to her password. The password is between 8-16 characters which is convenient as the pager can usually interpret only 140-160 characters.

9.3 Usability

There are three requirements that has a direct impact on the Clinical Decision Support System, as listed below –

9.3.1 Online Help

Online help manual and hard copy documentation shall be available for end-users in order to become more productive and use the full set of the features provided by the system.

9.3.2 Pager

The pager is critical and very important for the success of the system. It forms an integral part of the system. Every nurse is provided with a mandatory pager with a unique number. The application of mobile devices is prohibited in hospitals due to concerns. These pagers provide alerts and reminders about change in patient condition. The authorization requests sent by the moderators are also received by these pagers.

9.3.3 Browser

As the application is web-app, it requires a browser to run. Google Chrome and Mozilla Firefox are the recommended browsers to run the system.

9.4 Reliability

This section showcases the different reliability requirements of the Clinical Decision Support System.

9.4.1 Availability

The Clinical Decision Support System will be online, available and operational at all times. The downtime will only occur in case of system failure or maintenance. The time of downtime will not be more than 2 hours in a month. Maintenance will be periodically done monthly and every user will be notified about the time of downtime.

9.4.2 Mean Time Between Failures (MTBF)

The MTBF for the first deployed system will be less as bugs and user feedback about the system is inevitable. An estimate for the MTBF will range between 400-500 hours.

9.4.3 Mean Time to Repair

The Mean Time to repair shall not exceed 4 hours. However, that figure will vary based on the scale of the problem and the availability of maintenance personnel.

9.4.4 Accuracy

Accuracy is key to the success of the system. The system uses specific algorithms to generate accurate treatment plans for a specific wounds. A nurse's cooperation is crucial for this part. The information that she enters about the patient should be accurate. Any discrepancies should be avoided such that system generates accurate treatment plans. The system analyses entered patient info and compares it with the already existing patient database and treatment database

and devises a set of treatment plans with a set of problems that the plan might have. The treatment plans are ranked based on the rate of success and patient feedback in the past.

9.4.5 Maximum bugs or defects rate

The maximum defect rate that the application could support is 2% bugs/KLOC (thousands of lines of code).

9.4.6 Bugs or defects rate

A minor defect shall deviate the behavior of the system from what is expected while a critical defect shall cause the inability to use all the features of the system or leads to a system crash.

9.5 Performance

This section outlines the performance characteristics of the Clinical Decision Support System-

9.5.1 Response Time for a Request

The Clinical Decision Support System relies heavily on speed of results for success. It shall have an extremely fast response time. A treatment plan might take a while to be generated while a search request is instantaneous. A treatment plan may take up to 5-10 seconds to be generate. The retrieval of a search result would not be more than 0.10 seconds.

9.5.2 Throughput

Throughput for the Clinical Decision Support System is based on the data being transmitted. It can be a mail or a page to the nurse. The average rate of successful message delivery over the physical link would be 100 bits/s.

9.5.3 Capacity

The Clinical Decision Support System shall support multiple users on different workstations, but only a single unique user on a single workstation. The system is distributed over multiple workstations enabling multiple usages.

9.5.4 Database Access Response Time

The Clinical Decision Support System shall interact with a central database system allowing an access with no more than 8 seconds latency.

9.6 Supportability

This section indicates the set of requirements that will enhance the supportability or maintainability of the system being built.

9.6.1 Existing Patient Database of Previous Patients

To aid in devising an accurate treatment plan, the system accepts wound symptoms and other required info regarding patient such as allergies and compares it with the wound history of past patients and checks with patients that had similar characteristics in the database. The system then lists a set of treatment plans according to the success rates and then gives the user a list of treatment plans as a set of treatment plans. This existing patient database plays an important role in the success of the system.

9.7 Design Constraints

This part of the document lists the design constraints on the system which is being built.

9.7.1 Software Languages

The Clinical Decision Support System is only available in the English language. The success of the system will be measured and then language packs will be released in the future. English is the recommended language as most of the previous patient data is written in English. Therefore, the nurses should know Basic English and should have command and understanding on the clinical descriptions and jargon that the system displays.

9.7.2 Software Legacy System

The Clinical Decision Support System shall operate with appropriate algorithms and semantics of the programming language which will be used to build the system. This skeletal structure of the system will be communicating with the server on which the clinical database is stored.

9.7.3 Platform Requirements

The recommended platform requirements for the computer deploying the Clinical Decision Support System in order to support multiple users and enormous amount of data are -

Local Workstation Requirements

- Windows 7
- 4 GB Memory
- 80 GB hard drive
- Keyboard
- Mouse
- 15.6 inch TFT Monitor

Server and Database Requirements

- Windows 7 Professional
- 16GB Memory
- MySQL Database software
- Apache\Tomcat Service

The platform shall operate with a SQL server database management system to store, modify, and retrieve data.

9.8 Online User Documentation and Help System Requirements

The Clinical Decision Support System provides online documentation in order to familiarize end-users with the system and properly use its full features. The Help button shall be located in the menu bar. After the mouse click, a web page navigator should be opened and should load the corresponding help ID from the SQL database. The help menu window shall contain a list of all the main topics in ascending alphabetical order.

9.9 Purchased Components

In order to respect the implementation standards like naming and coding conventions and ensure code inspections, refactoring, and fast navigation, an IDE's plug-in should be used: CodeEnhance. This tool requires a license to enable software developers to use the full set of features it provides.

9.10 Interfaces

This section defines the interfaces that must be supported by the application.

9.10.1 User Interfaces

The Clinical Decision Support System user interfaces shall be interactive and user friendly. The GUI shall adopt eye-friendly colors and shall contain only the necessary fields that are required for the nurses. Please refer to the following figures of the User Interfaces to get a better idea of how the system will look like.

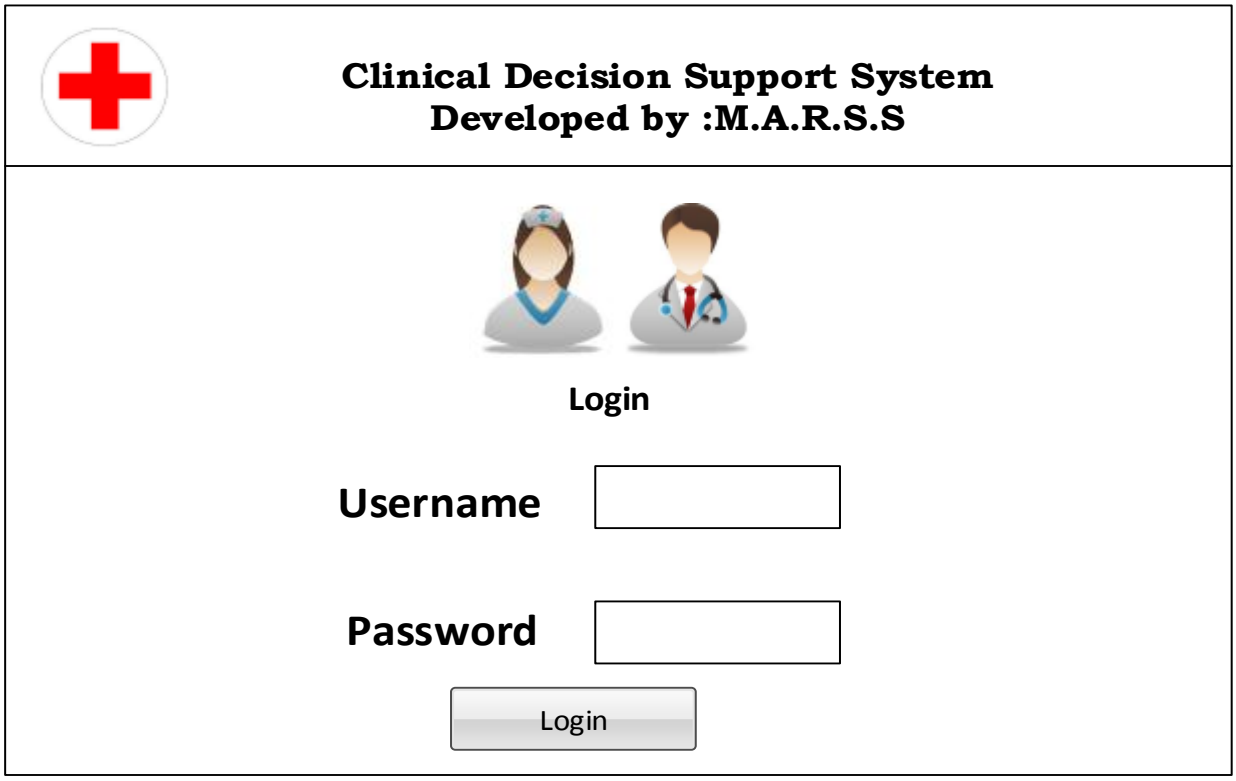

Figure 2: Login Screen

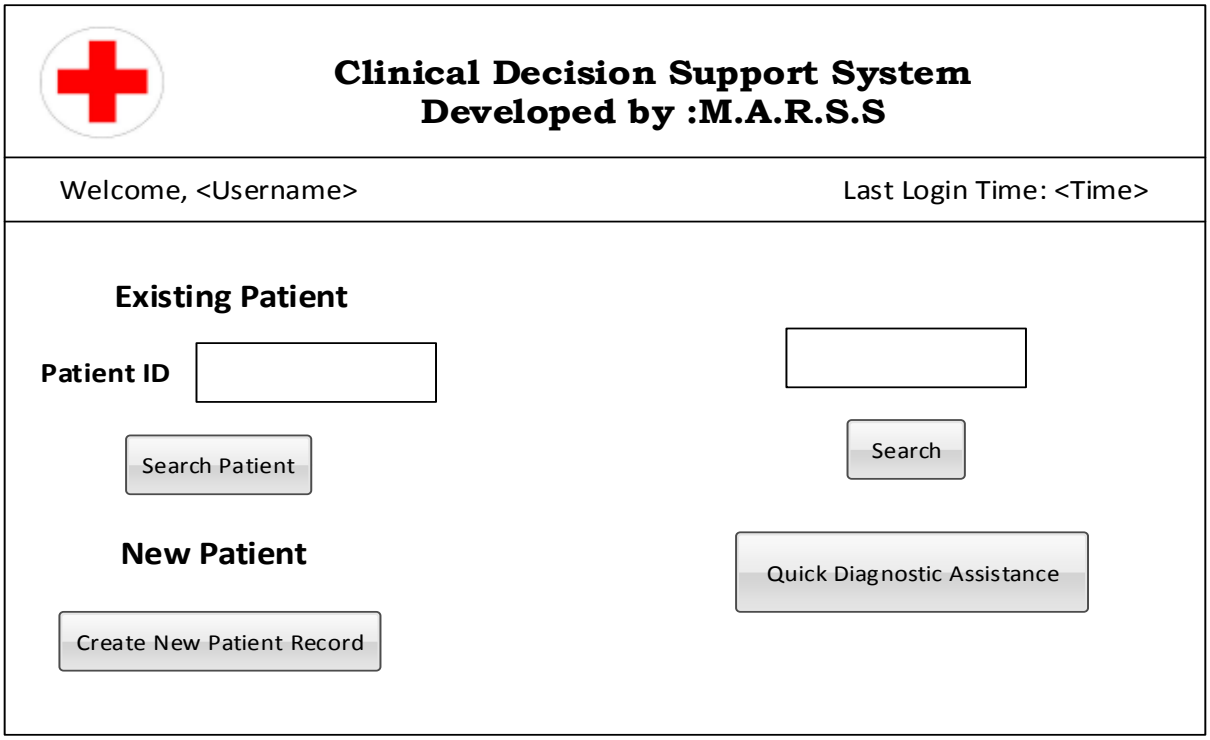

Figure 3: Main Screen

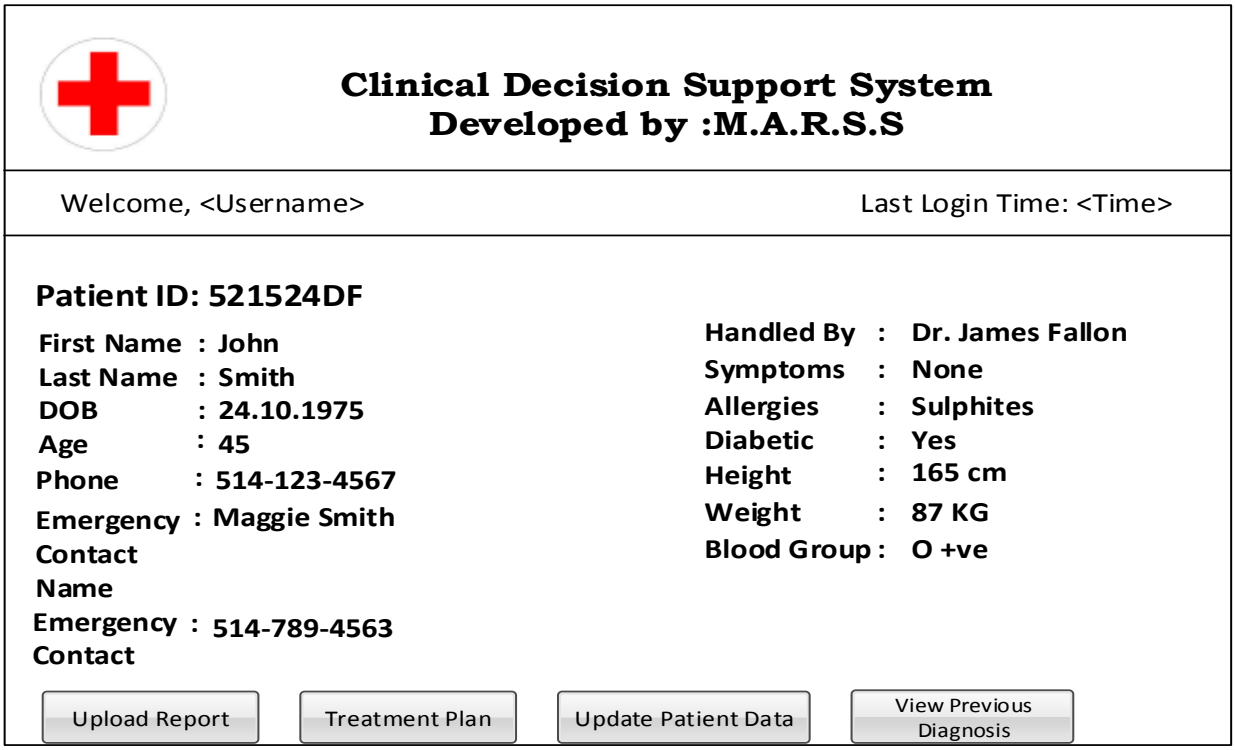

Figure 4: Patient Form Screen

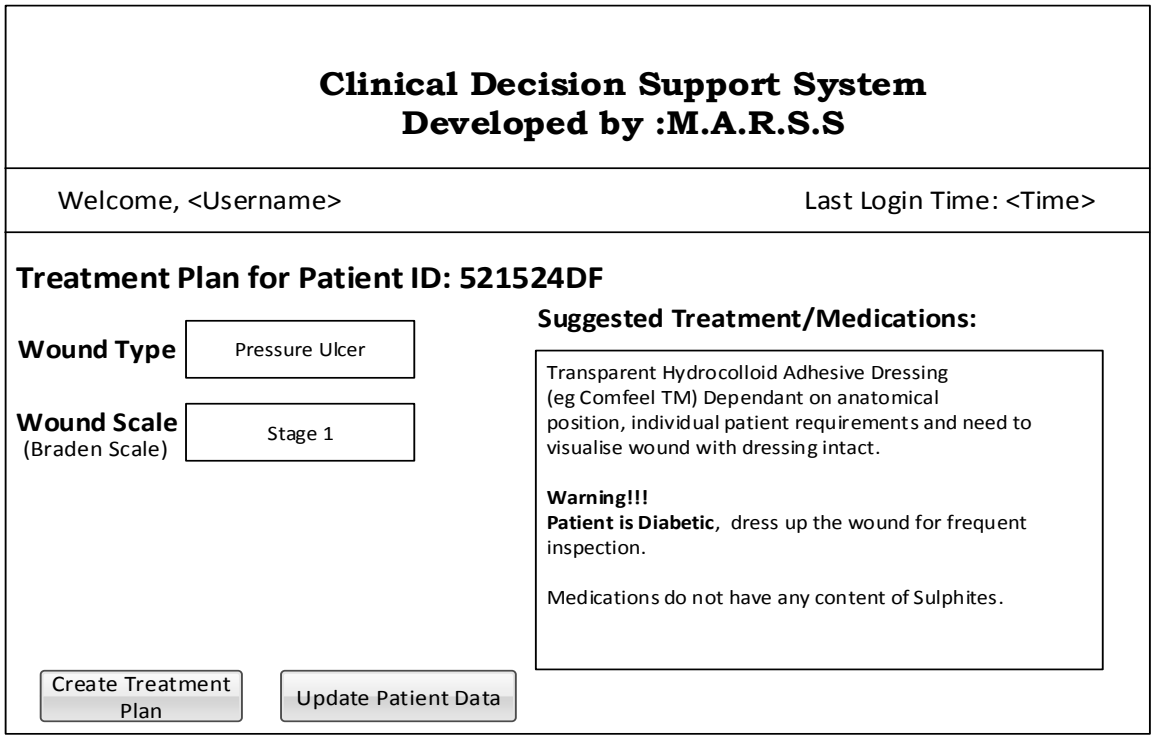

Figure 5: Treatment Plan Screen

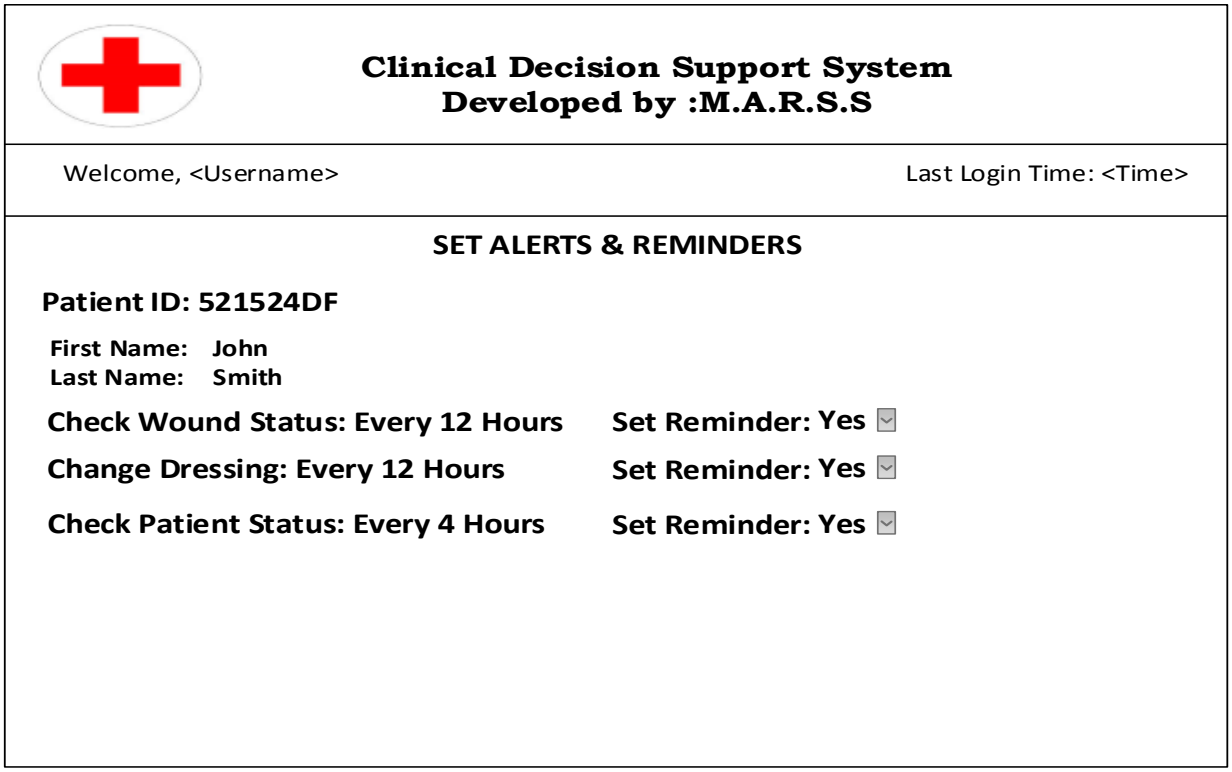

Figure 6: Set Alerts and Reminders Screen

Clinical Decision Support System
Developed by :M.A.R.S.S

Welcome, <Username> Last Login Time: <Time>

Quick Diagnostic Assistance

Search Results for "Pressure Injuries"

Pressure Injuries					
Picture of wound	**Wound**	**Indicator/descriptor**	**Management Aims**	**Product recommendations**	**Relevant Links**
	**Stage 1 Pressure injury** Non Blanchable Erythema	Intact skin with non-blancable redness of a localised area usually over a bony prominence. May be painful, firm, soft, warm or cool. May be difficult to detect in darker skin tones. May identify 'at risk' individuals.	Protect to prevent further injury	Transparent Hydrocolloid Adhesive Dressing (eg Comfeel TM) *Dependant on anatomical position, individual patient requirements and need to visualise wound with dressing intact*	Pressure Injury Prevention and Management Clinical Guideline
	**Stage 2 Pressure Injury** Partial Thickness Skin Loss	Partial thickness skin loss of dermis presenting as shallow, open wound with a red-pink wound bed, with no slough. May present as intact or ruptured serum filled blister. A shiny or dry, shallow ulcer without slough or bruising	Relieve pressure and protect wound from further trauma and contamination	Silcone Adhesive or non adherent foam may be considered	Pressure Injury Prevention and Management Clinical Guideline
	**Stage 3 Pressure injury** Full thickness Skin Loss	Full thickness tissue loss, subcutaneous fat may be visable but bone, tendon or muscle are not exposed. Slough may be present. Depth will depend on anatomical location	Relieve pressure and protect wound from further trauma and contamination	These wounds need thorough assessment to determine appropriate management. Hydrogel, Adhesive foam, Hydrofibre, Alginate or Silicone dressings may be considered	Pressure Injury Prevention and Management Clinical Guideline

Figure 7: Quick Diagnostic Assistance Screen

9.10.2 Hardware Interfaces

The hospital's Local Area Network shall be used in order to communicate with the central database server. For further description of the hardware interfaces, please refer to the platform requirements section.

9.10.3 Software Interfaces

The Clinical Decision Support System is a web-app and requires a browser to run. The recommended browsers are Google Chrome and Mozilla Firefox. The system shall be used with lightweight SQL version Database management System that will be installed on hospital's workstations. For further description of the hardware interfaces that are going to interact with the software interfaces, please refer to the platform requirements section.

9.10.4 Communication Interfaces

The Clinical Decision Support System shall communicate with legacy applications through the Local Area Network.

9.11 Licensing Requirements

Initially for the Clinical Decision Support System delivery, the system usage is restricted to the healthcare industry. The feedbacks are collected from the nurses and doctors in order to improve the system for improving and implementing newer features in the system.

9.12 Legal, Copyright and Other Notices

The Clinical Decision Support System is a trademark of the people and stakeholders that are responsible for building the system. The software shall not be copied or used without the permission of these individuals.

9.13 Applicable Standards

A couple of criteria shall be applied to the Clinical Decision Support System in order to follow the international Organization for Standardization ISO9000 standards. This will address various aspects of quality management to provide guidance so as to ensure that the final product meets the client's requirements with a focus on quality improvement.

10. Use Cases

10.1 Use Case Context Diagram

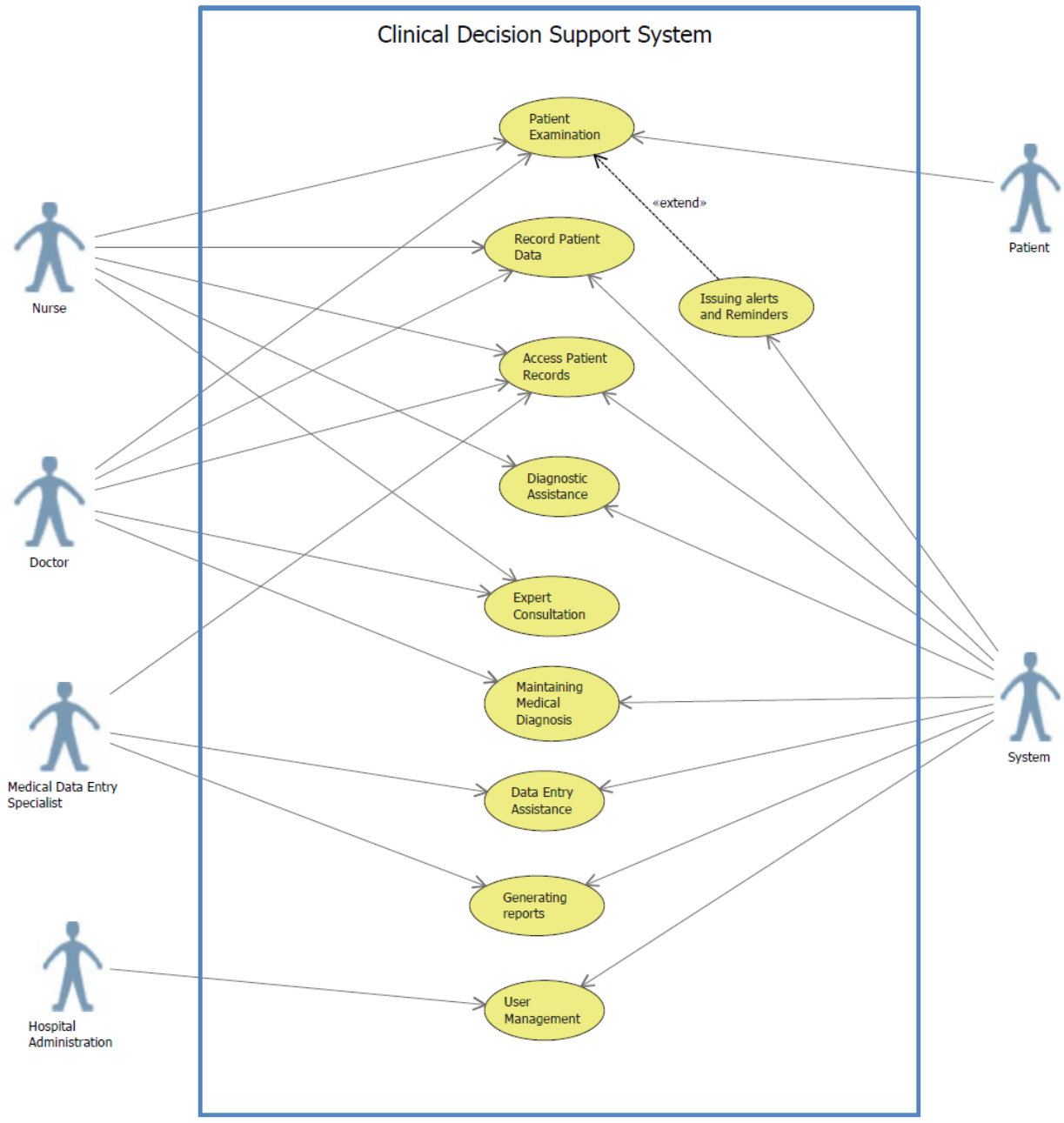

Figure 8: Use Case Context Diagram (CDSS)

10.2 Use Case Briefs

10.2.1 Patient Examination

Actor: Nurse, Patient

The wound nurse checks the current health status of patient by monitoring the instruments and examines the patient with appropriate diagnostic treatment plan. As a result, the nurse starts patient diagnosis by selecting appropriate treatment plan from the system in the smallest amount of time as possible without consulting others. The nurse records the patient examination data and may assign new medical prescription based on the patient health.

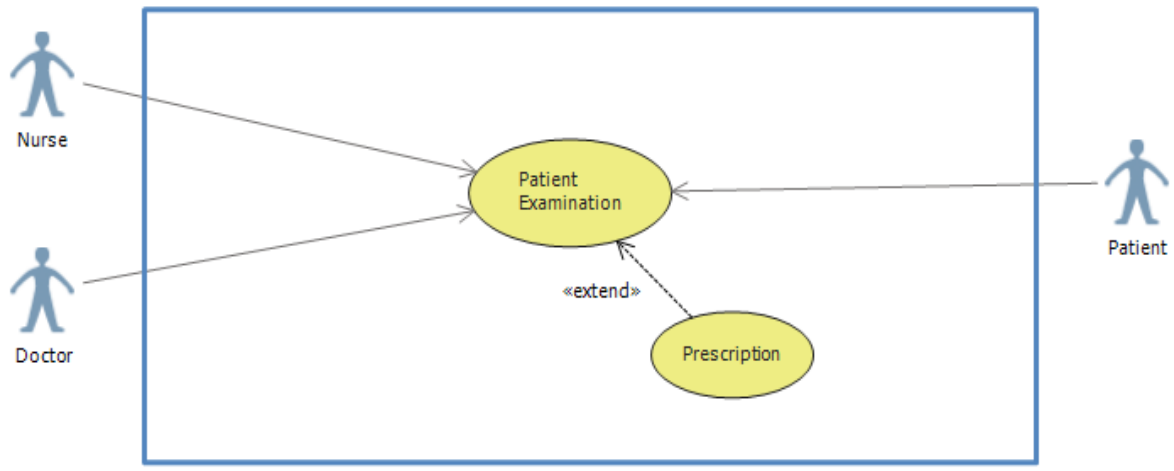

Figure 9: Patient Examination Use Case Diagram

10.2.2 Record Patient Data

Actor: Nurse

The nurse collects information related to patient like symptoms, allergies and other health related conditions. The nurse records patient data into the system by logging in with their identity credentials. The system updates the patient data and maintains patient medical records based on the nurse examination. As a result, system will keep monitoring the patient based on the records available.

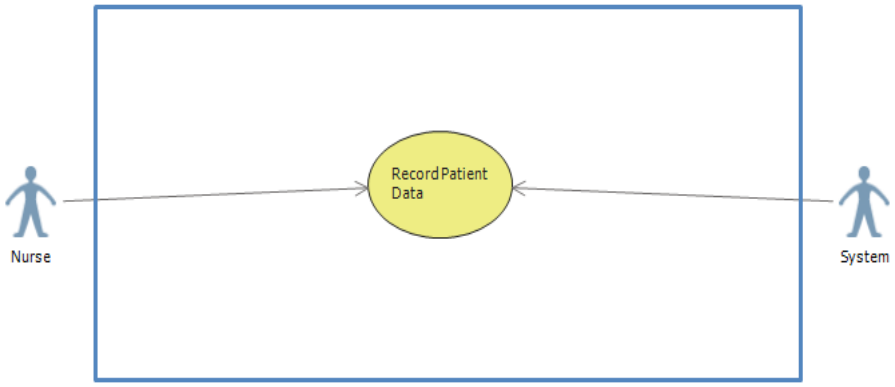

Figure 10: Record Patient Data Use Case Diagram

10.2.3 Access Patient Records

Actor: Nurse, Doctor, Medical Data Entry Specialist

Before visiting a patient for treatment, the nurse can access patient data or medical records by searching patient in the system database. It includes information retrieval from the system by formulating search queries and performing patient information extraction. The nurse/doctor can examine the patient recovery towards a treatment plan by looking at the patient records.

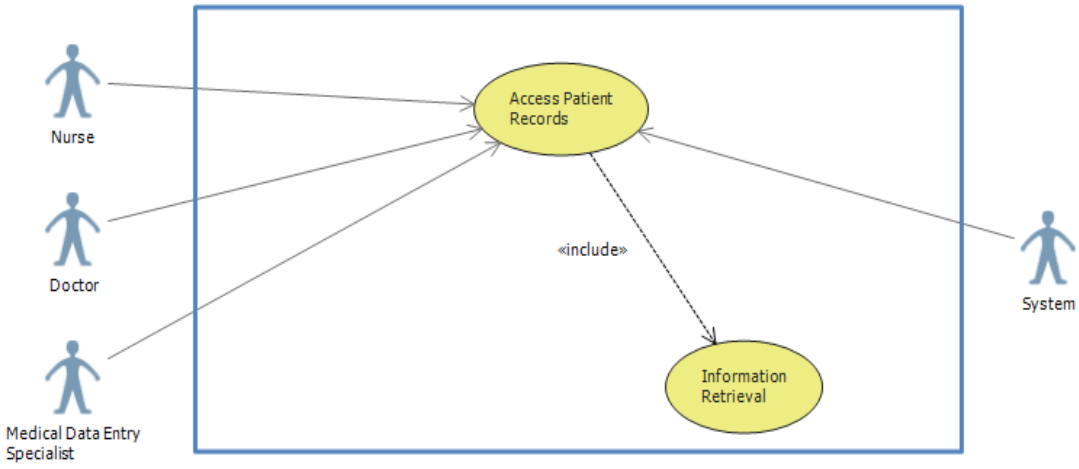

Figure 11: Access Patient Records Use Case Diagram

10.2.4 Diagnostic Assistance

Actor: Nurse

The nurse performs diagnostic assistance by searching for a keyword or by entering various fields like symptoms, allergic to, type of wound etc. for listing more specific treatment plan. The system also suggests a potential diagnoses based on the patient data and helps the nurse in identifying potential medical conditions for rare symptoms. The nurse can also perform a quick diagnostic assistance in case of emergencies.

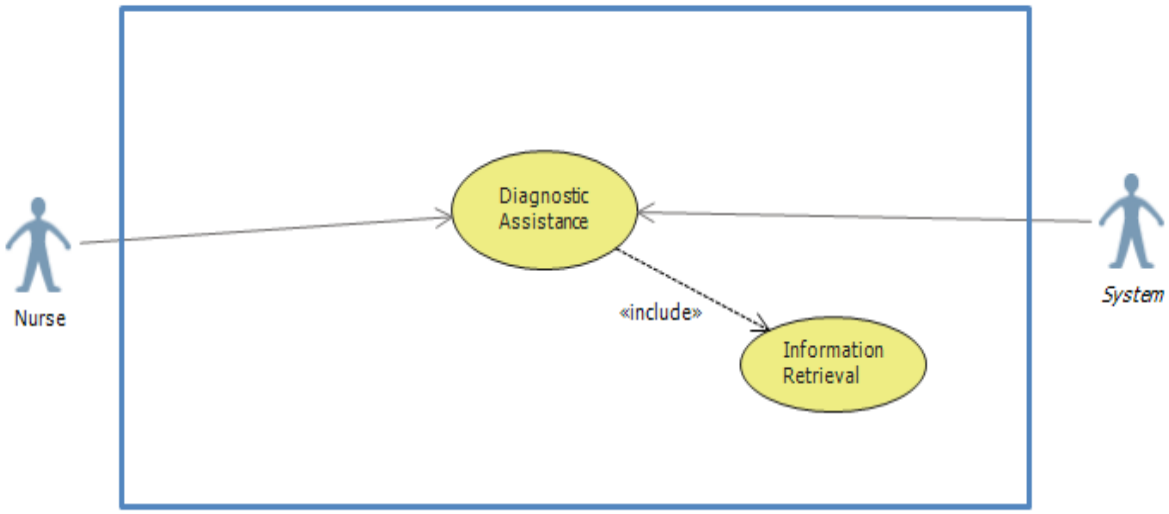

Figure 12: Diagnostic Assistance Use Case Diagram

10.2.5Maintaining Medical Diagnosis

Actor: Doctor

The doctor maintains medical diagnosis by adding or updating diagnosis based on his/her expert knowledge and valuable experience. He/she can also search for the available diagnosis from the system. As a result, doctor makes sure that there is always information available in the system to make clear and accurate decision for wound care management. The doctor will save new treatment plans whenever available into the system. Only doctors are authorized to maintain medical diagnosis.

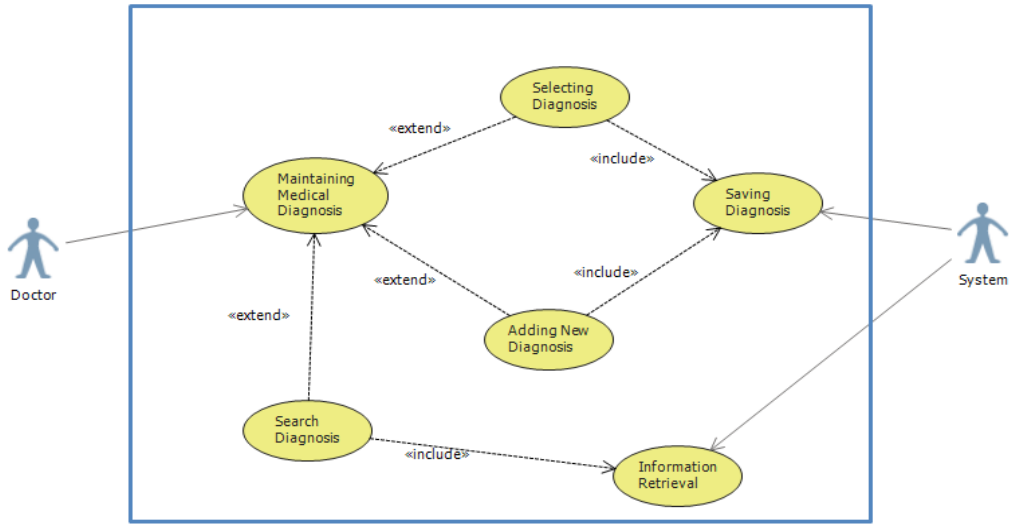

Figure 13: Maintaining Medical Diagnosis Use Case Diagram

10.2.6 Expert Consultation

Actor: Nurse, Doctor

The nurse can consult the doctor for recommended products, dressing and cleansing agent for the wound. Expert information from doctor will help the nurse in deciding the healing process and its effectiveness based on the patient condition.

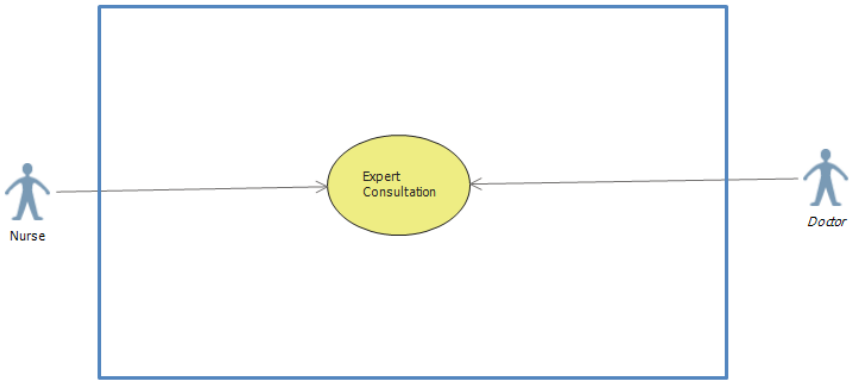

Figure 14: Expert Consultation Use Case Diagram

10.2.7 Data Entry Assistance

Actor: Medical Data Entry Specialist

The medical data entry specialist updates patient data and medical records based on the nurse requests. He/she requires to log into the system to record data like orders and inventory, medications and lab tests related to the patient. He/she also adds task and reminders related to patient and makes sure that it's taken care by the assigned nurse. Assisting nurse in data entry related to the patient.

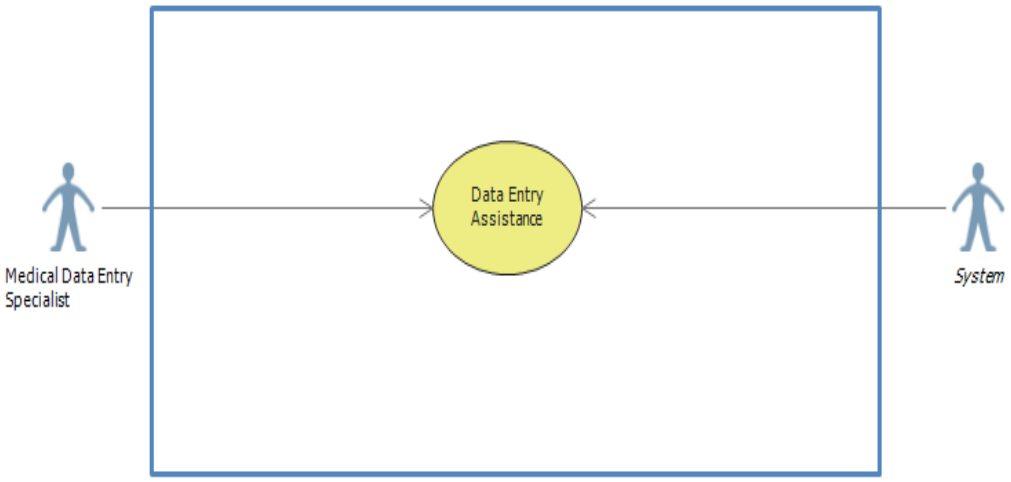

Figure 15: Data Entry Assistance Use Case Diagram

10.2.8 Generating Reports

Actor: Medical Data Entry Specialist

The medical data entry specialist can access patient records and generate reports based on the nurse requests. The system fetches the requested query from the database and generates the report. System also provides an option for printing those reports to the nearest connected printers. He/she can save the reports for future use into the system.

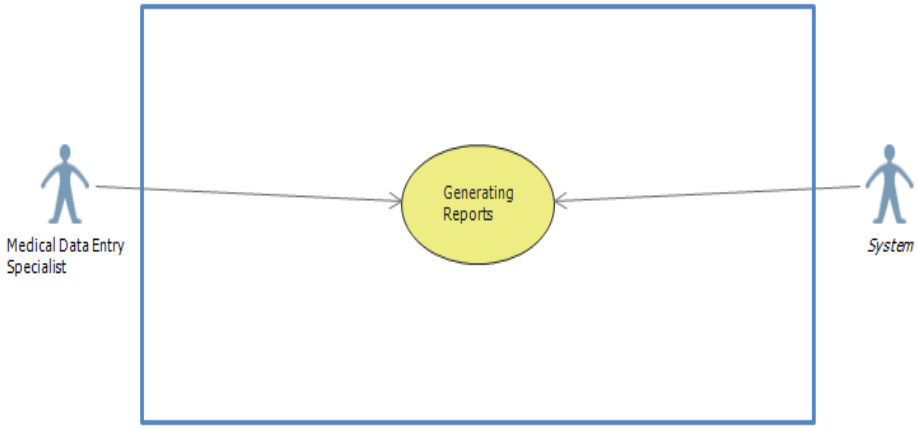

Figure 16: Generating Reports Use Case Diagram

10.2.9 Issuing Alerts and Reminders

Actor: Nurse

The system is integrated with the instruments continuously monitoring the patient conditions and alerts the assigned nurse in case of severe change in patient condition. System also sends continuous reminders to the nurse based on the scheduled task like change in dressing, applying vaccination etc. The nurse gets alerts on her pager from the system if there are any adverse effects of possible drug interaction on the patient. The system communicates to the nurse pager by sending notifications in case of any emergencies.

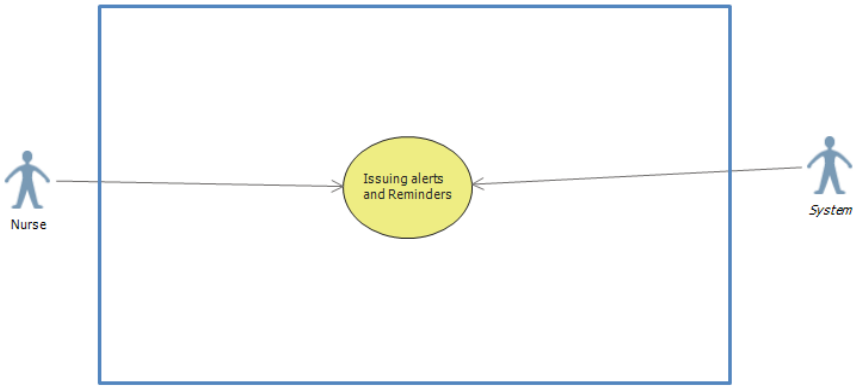

Figure 17: Issuing Alerts and Reminders Use Case Diagram

10.2.10 User Management

Actor: Hospital Administration

The hospital administration staff requires to login to the system for managing the users. The system provides an option for adding or updating the user profile. The user can request for a change in his/her profile or login credentials, based on which the administration can search the user in the system and updates the requested information.

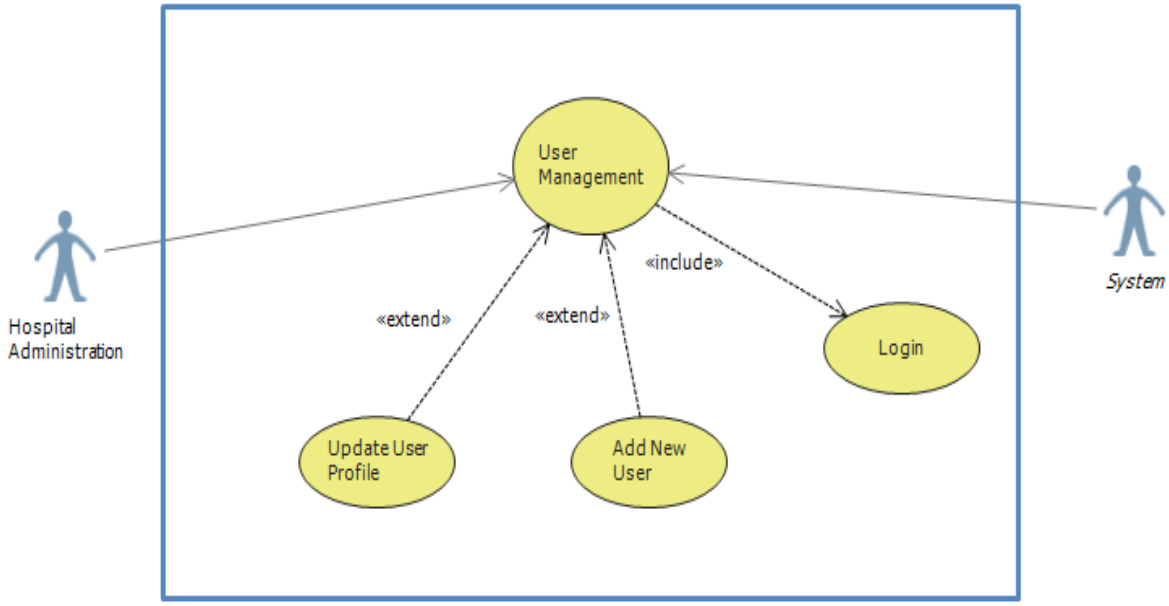

Figure 18: User Management Use Case Diagram

10.3 Requirements Prioritization – Cost Value Prioritization

Cost Value Prioritization gives us an idea of how much a requirement contributes towards the project's cost and value. The assessment of the cost and values contributed to the project by each specific requirement is arrived via Analytic Hierarchy Process. Given a list of requirements, we assign a scale to them to reflect how much each requirement contributes towards each of the criterion of the list of criteria deemed important.

We have two criteria to evaluate the requirements against.

Criterion 1: Cost

Criterion 2: Value

We define the scale used in the cost value prioritization for the Nursing Decision Support System as follows

1	contributed equally
3	contributes slightly more
5	contributes strongly more
7	contributes very strongly more
9	contributes extremely more

We use this scale to compare the list of requirements pair wise. The pair wise comparison is facilitated by the use of a comparison matrix.

Comparison Matrix Definition:

If R is a requirement, it ranges between $R_1 – R_N$, where N is the number of requirements .In a comparison matrix, $R_{ij} = 1/R_{ji}$ $(1 \leq i, j \leq N)$ i and j denoting the rows and columns respectively. An entry for Requirements Ri and RJ in a comparison matrix E such that

$$E = (R_i, R_j) = N$$

means that R_i contributes N times more than R_j in regard to the criterion in question.

10.3.1. Comparison Matrix: Value

Priority and Scale assignment:

The following important features were selected based on their importance towards the system's functionality and user's needs. The user's needs were prioritized previously which were helpful in assigning the scales accordingly.

Comfortable User Interface (CUI)	Low	1
Expert Consultation (EC)	MODERATE	3
User Management (UM)	MODERATE	5
Generating Reports (GR)	MODERATE	5
Patient Examination (PE)	MODERATE	7
Record Patient Data (RPD)	HIGH	7
Maintaining Medical Diagnosis (MMD)	HIGH	7
Access Patient Records (APR)	HIGH	9
Data Entry Assistance (DEA)	HIGH	9
Issuing Alerts and Reminders (ISA)	HIGH	9
Diagnostic Assistance (DA)	HIGH	9

Comparison Matrix:

The Comparison matrix is used to evaluate how the criterion distributes among all requirements.

Value	**DA**	**ISA**	**DEA**	**APR**	**MMD**	**RPD**	**PE**	**GR**	**UM**	**EC**	**CUI**
DA	1	1	3	3	5	5	5	7	7	9	9
ISA	1	1	3	3	7	5	5	5	7	9	9
DEA	1/3	1/3	1	1	3	3	5	3	5	9	9
APR	1/3	1/3	1	1	3	3	3	3	5	7	9
MMD	1/5	1/7	1/3	1/3	1	1	3	5	7	7	7
RPD	1/5	1/5	1/3	1/3	1	1	3	5	3	7	7
PE	1/5	1/5	1/5	1/3	1/3	1/3	1	3	5	5	7
GR	1/7	1/5	1/3	1/3	1/5	1/5	1/3	1	3	5	5
UM	1/7	1/7	1/5	1/5	1/7	1/3	0	1/3	1	3	3
EC	1/9	1/9	1/9	1/7	1/7	1/7	1/5	1/5	1/3	1	3
CUI	1/9	1/9	1/9	1/9	1/7	1/7	1/7	1/5	1/3	1/3	1

Normalized Comparison Matrix

The Columns in the Comparison matrix are normalized R'ij =Rij/∑Rij.

Relative Value is calculated as the average of the entries across the lines

Contribution (Ri, Criterion) = ∑j R'ij/N

Value	DA	IAR	DEA	APR	MMD	RPD	PE	GR	UM	EC	CUI	**Rel. Val**
DA	0.26	0.26	0.31	0.31	0.24	0.26	0.19	0.21	0.16	0.14	0.13	**0.23**
IAR	0.26	0.26	0.31	0.31	0.33	0.26	0.19	0.15	0.16	0.14	0.13	**0.23**
DEA	0.09	0.09	0.10	0.10	0.14	0.16	0.19	0.09	0.11	0.14	0.13	**0.12**
APR	0.09	0.09	0.10	0.10	0.14	0.16	0.12	0.09	0.11	0.11	0.13	**0.11**
MMD	0.05	0.04	0.03	0.03	0.05	0.05	0.12	0.15	0.16	0.11	0.10	**0.08**
RPD	0.05	0.05	0.03	0.03	0.05	0.05	0.12	0.15	0.07	0.11	0.10	**0.08**
PE	0.05	0.05	0.02	0.03	0.02	0.02	0.04	0.09	0.11	0.08	0.10	**0.06**
GR	0.04	0.05	0.03	0.03	0.01	0.01	0.01	0.03	0.07	0.08	0.07	**0.04**
UM	0.04	0.04	0.02	0.02	0.01	0.02	0.00	0.01	0.02	0.05	0.04	**0.02**
EC	0.03	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.04	**0.02**
CUI	0.03	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	**0.01**
SUM	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**0.99**	**1.00**	**1.00**	**1.00**	**1.00**	

10.3.2. Comparison Matrix: Cost

Priority and Scale assignment:

Cost and Scale assignment is arrived at after the entire team discussed and decided on which requirements are likely to contribute more towards the cost of the project and scales are assigned accordingly.

Comfortable User Interface	1
Expert Consultation	1
User Management	5
Generating Reports	3
Patient Examination	3
Record Patient Data	5
Maintaining Medical Diagnosis	5
Access Patient Records	7
Data Entry Assistance	9
Issuing Alerts and Reminders	9
Diagnostic Assistance	7

The Comparison Matrix for Cost, is built the same way as the Matrix for Value criterion following the same set of steps. The resultant matrix and the normalized matrix with the Criterion as Cost is shown below.

Comparison Matrix:

Cost	DA	ISA	DEA	APR	MMD	RPD	PE	GR	UM	EC	CUI
DA	1	1/3	1/3	1	3	3	5	5	7	7	9
ISA	3	1	1	3	5	5	7	7	5	9	9
DEA	3	1	1	3	5	5	7	7	5	9	9
APR	1	1/3	1/3	1	3	3	5	5	7	9	9
MMD	1/3	1/5	1/5	1/3	1	1	3	3	1	5	7
RPD	1/3	1/5	1/5	1/3	1	1	3	3	1	5	5
PE	1/5	1/7	1/7	1/5	1/3	1/3	1	1	1/3	3	3
GR	1/5	1/7	1/7	1/5	1/3	1/3	1	1	3	3	3
UM	1/7	1/5	1/5	1/7	1	1	3	1/3	1	5	5
EC	1/7	1/9	1/9	1/9	1/5	1/5	1/3	1/3	1/5	1	1
CUI	1/9	1/9	1/9	1/9	1/7	1/5	1/3	1/3	1/5	1	1

Normalized Comparison Matrix:

Cost	DA	ISA	DEA	APR	MMD	RPD	PE	GR	UM	EC	CUI	**Rel. Cost**
DA	0.11	0.09	0.09	0.11	0.15	0.15	0.14	0.15	0.23	0.12	0.15	**0.13**
ISA	0.32	0.26	0.26	0.32	0.25	0.25	0.20	0.21	0.16	0.16	0.15	**0.23**
DEA	0.32	0.26	0.26	0.32	0.25	0.25	0.20	0.21	0.16	0.16	0.15	**0.23**
APR	0.11	0.09	0.09	0.11	0.15	0.15	0.14	0.15	0.23	0.16	0.15	**0.14**
MMD	0.04	0.05	0.05	0.04	0.05	0.05	0.08	0.09	0.03	0.09	0.11	**0.06**
RPD	0.04	0.05	0.05	0.04	0.05	0.05	0.08	0.09	0.03	0.09	0.08	**0.06**
PE	0.02	0.04	0.04	0.02	0.02	0.02	0.03	0.03	0.01	0.05	0.05	**0.03**
GR	0.02	0.04	0.04	0.02	0.02	0.02	0.03	0.03	0.10	0.05	0.05	**0.04**
UM	0.02	0.05	0.05	0.02	0.05	0.05	0.08	0.01	0.03	0.09	0.08	**0.05**
EC	0.02	0.03	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	**0.02**
CUI	0.01	0.03	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	**0.01**
SUM	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	

The Cost v/s Value Percentages Graph for Prioritization:

Using these Relative Cost and Value percentages, the cost value graph is plotted. The cost – value graph shows the requirements which fall under the Low, High or Medium priority.

	Relative Cost Percentage	Relative Value Percentage
DA	13%	23%
ISA	23%	23%
DEA	23%	12%
APR	14%	11%
MMD	6%	8%
RPD	6%	8%
PE	3%	6%
GR	4%	4%
UM	5%	2%
EC	2%	2%
CUI	1%	1%

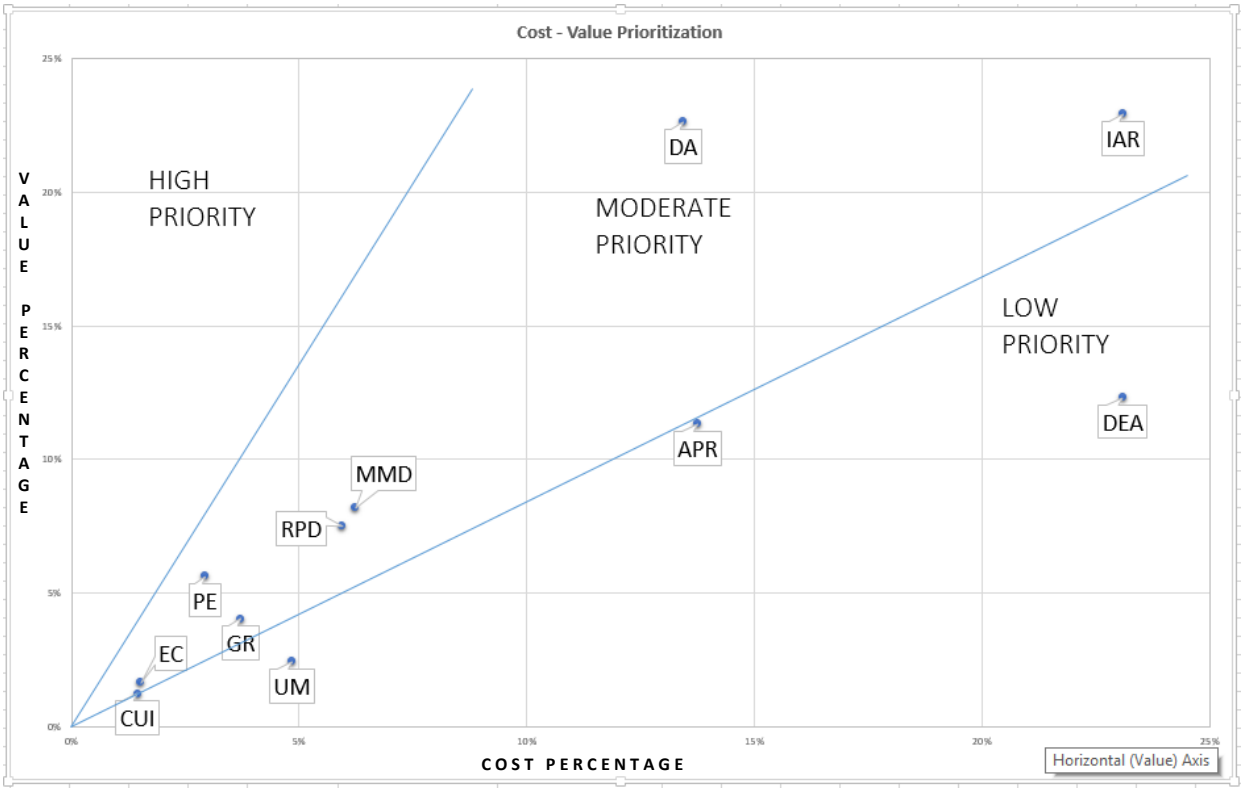

Figure 19: Cost - Value Graph

10.4 Fully Dressed Use Cases

10.4.1 Record Patient Data

Use Case Name	Record Patient Data
Use Case ID	UC_RecordPatientData
Primary Actor	Nurse
Stakeholders and Interests	Nurse: wants to record patient information and medical history in a more efficient way
Preconditions	Nurse is identified and authenticated by the system.
Post conditions	Patient data is created or updated into the system.
Main Success Scenario	1. The nurse provides login credentials to enter the system. 2. System authenticates the nurse credentials and shows menu based on the nurse privileges. 3. The nurse has the option of creating a new patient record or search for an existing patient on the Search Patient menu and then enters the patient name or id. 4. System connects to the database and displays the patient data. 5. The nurse enters all medical records and change of prescription in the form. 6. The nurse clicks on Save button to update patient record. 7. System collects all form information and saves data into the database based on the patient id. System creates a new record if patient is new and does not exists in the database. 8. System displays confirmation message after saving the record. 9. The nurse exits the system by pressing logout button. 10. System clears all session of the logged in nurse and shows successful logout message.

Extensions	2a. If invalid login details. System throws error. 1. The nurse re-enters login credentials. 2. Flow goes back to 2 in main success scenario. 3a. Nurse enters invalid patient data that does not exists in the database. 1. System will throw validation message and requests nurse to enter valid patient data. 2. Flow goes back to 3 in main success scenario. 4a. System fails to retrieve patient records by name or id. 1. System tries to connect to database again by performing test connections. 2. If success, flow goes back to 4 in main scenario. 7a. System fails to insert patient data into the database. 1. System writes the form data into the text file and prompts the nurse to save the data. 2. The nurse backups the log file in to his/her system for recording unsaved data in future. 3. Flow goes back to 3 in main success scenario. 10a. System is not able to log out the user. 1. System redirects the nurse to home page and requests to press Logout again. 2. Flow goes back to 9 in main success scenario.
Special Requirements	Nurse requires system to be reliable and easy to use for entering patient data.
Technology and Data Variations List	Reporting tool to generate patient data and laser printer connected in networks for printing patient medical records
Frequency of Occurrence	Continuously used by the nurse and doctor to keep track for patient medical records.

Miscellaneous	What happens if the system is not able to save patient records in the system? System can retrieve information from stored text files saved by the nurse and re-tries to insert data by reading files. On success, system deletes the particular file so that it doesn't duplicates the patient record.

10.4.2 Diagnostic Assistance

Use Case Name	Diagnostic Assistance
Use Case ID	UC_DiagnosticAssistance
Primary Actor	Nurse
Stakeholders and Interests	Nurse: wants accurate and fast retrieval of potential diagnoses based on patient data and identifying potential medical conditions for rare symptoms.
Preconditions	Nurse is identified and authenticated by the system.
Post conditions	System displays list of diagnoses based on the nurse input data. Nurse selects appropriate treatment plan based on the patient medical status.
Main Success Scenario	1. The nurse provides login credentials to enter the system. 2. System authenticates the nurse credentials and shows menu based on the nurse privileges. 3. The nurse clicks on the Diagnostic Assistance menu link. 4. System displays Diagnostic Assistance form including fields like Search by Keyword, symptoms, allergies or by patient data. 5. The nurse enters all potential search details that will provide

	accurate diagnoses plan. 6. System performs Information retrieval based on the search query by connecting to the system database. 7. System displays all possible diagnoses based on the output generated by information retrieval. 8. The nurse selects appropriate diagnoses matching patient records and takes suggested measures. 9. The nurse exists the system by pressing logout button. 10. System clears all session of the logged in nurse and shows successful logout message.
Extensions	2a. If invalid login details. System throws error. 1. The nurse re-enters login credentials. 2. Flow goes back to 2 in main success scenario. 5a. Nurse enters invalid or empty data for search. 1. System will throw validation message and requests nurse to provide valid data. 2. Flow goes back to 5 in main success scenario. 6a. System fails to connect to database. 1. System tries to connect to database again by performing test connections. 2. If success, flow goes back to 6 in main scenario. 2a. If error, system gives error displaying not able to perform operation and flow goes back to 5. 6b. Session timeout error by database not able to process query. 1. System displays error and prompts the nurse to perform diagnostic assistance again. 2. Flow goes back to 3 in main success scenario. 10a. System is not able to log out the user. 1. System redirects the nurse to home page and requests to

	press Logout again. 2. Flow goes back to 9 in main success scenario.
Special Requirements	Form View should be simple and easy to use. Faster and optimized information retrieval based on search data.
Technology and Data Variations List	Laser printers to print suggested diagnoses and potential treatment prescriptions for rare symptoms.
Frequency of Occurrence	Very often. Continuously used by the nurse and doctors for patient examination.
Miscellaneous	Requires a very good internet connection and faster processor for retrieving diagnoses from the system database in short time. What happens if the system is not able to connect to database while performing information retrieval? System can retrieve information stored in cache memory based on the previous search.

10.4.3 Data Entry Assistance

Use Case Name	Data Entry Assistance
Use Case ID	UC_Data Entry Assistance
Primary Actor	Medical Data Entry Specialist
Stakeholders and Interests	Nurse: wants accurate data to be entered related to patient info and medical history. Doctor: monitors patient health status by looking at medical records requires precise and accurate data entry
Preconditions	Medical Data Entry Specialist is identified and authenticated by the system.
Post conditions	Data related to orders for medications, lab tests and patient data is correctly entered into the system.

Main Success Scenario	1. The medical data entry specialist provides login credentials to enter the system. 2. System authenticates the credentials and shows menu based on authorization. 3. Data Entry Specialist selects Manage Patient Records in order to assist nurse in patient information data entry. 4. The nurse approves the data entered and Data Entry Specialist clicks on Save button to update patient record. Requesting nurse gets assigned to changes made in patient records. 5. System collects all form information and saves data into the database based on the patient id. System creates a new record if patient is new and does not exists in the database. 6. Data Entry Specialist selects Manage Orders for entering medication and lab tests orders. He/she can also upload scan copy of the receipts. 7. System calculates sub-total and total amount based on line items and saves record into the system. 8. System displays confirmation message after saving the record based on the operation performed. 9. System provides an option for printing the orders and patient records after save operation. 10. The medical data entry specialist exists the system by pressing logout button. 11. System clears all session of the logged in nurse and shows successful logout message.
Extensions	2a. If invalid login details. System throws error. 1. The data entry specialist re-enters login credentials. 2. Flow goes back to 2 in main success scenario. 3a. Data entry specialist enters invalid patient data that does not

	exists in the database. 1. System will throw validation message and requests the user to enter valid patient data. 2. Flow goes back to 3 in main success scenario. 6a. Storage space exceeds, unable to upload scan receipts. 1. System automatically creates a new virtual space on another server and performs disk allocation. 2. System uploads the document on the new allocated disk space. 3. Flow goes back to 7 in main success scenario. 7a. Wrong calculation of sub-totals and total by the system. 1. Data entry specialist selects an option to manually modify sub-total and total information. 2. System uses the entered value to save the data and flow goes back to 8 in main success scenario. 9a. System is not able to print reports due to connection failure. 1. System performs a lookup operation to find nearest printer which is online. 2. Submits printing job to that printer and notifies the user about the printer location. 3. Flow goes back to 10 in main success scenario. 11a. System is not able to log out the user. 1. System redirects the nurse to home page and requests to press Logout again. 2. Flow goes back to 9 in main success scenario.
Special Requirements	Reliable and easy to use for assisting in entering data in short amount of time.

Technology and Data Variations List	Scanners to scan orders receipt and laser printers for printing records. Reporting tool to generate reports and summary.
Frequency of Occurrence	Will be frequently used in assisting in data entry related to patients and orders.
Miscellaneous	What happens if the system is not able to save data in the system? System can retrieve information from stored text files saved by the data entry specialist and re-tries to insert data by reading files. On success, system notifies the associated user about the operation being performed.

11. Domain Model

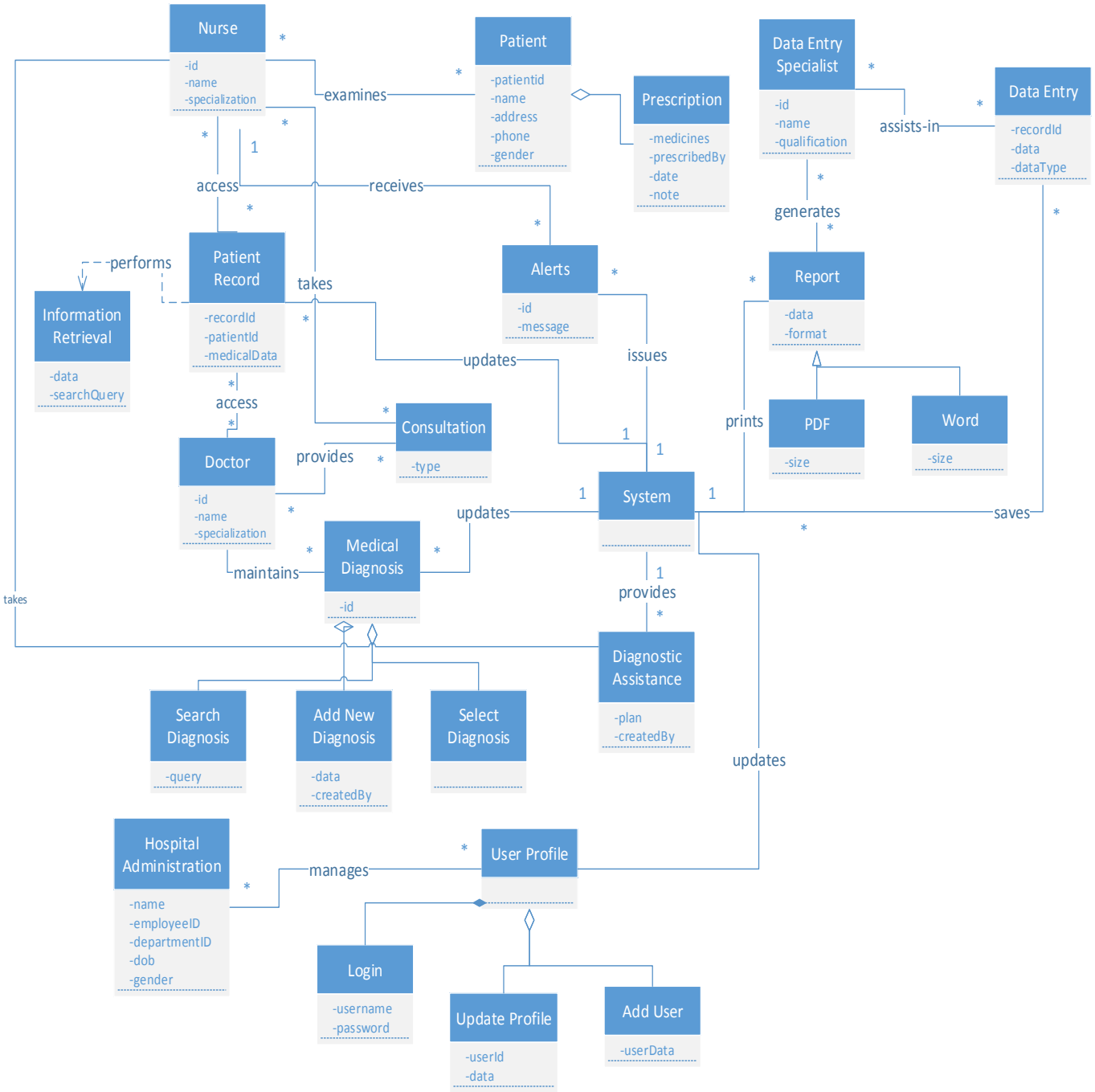

Figure 20: Domain Model Diagram

12. System Sequence Diagram

12.1 Record Patient Data

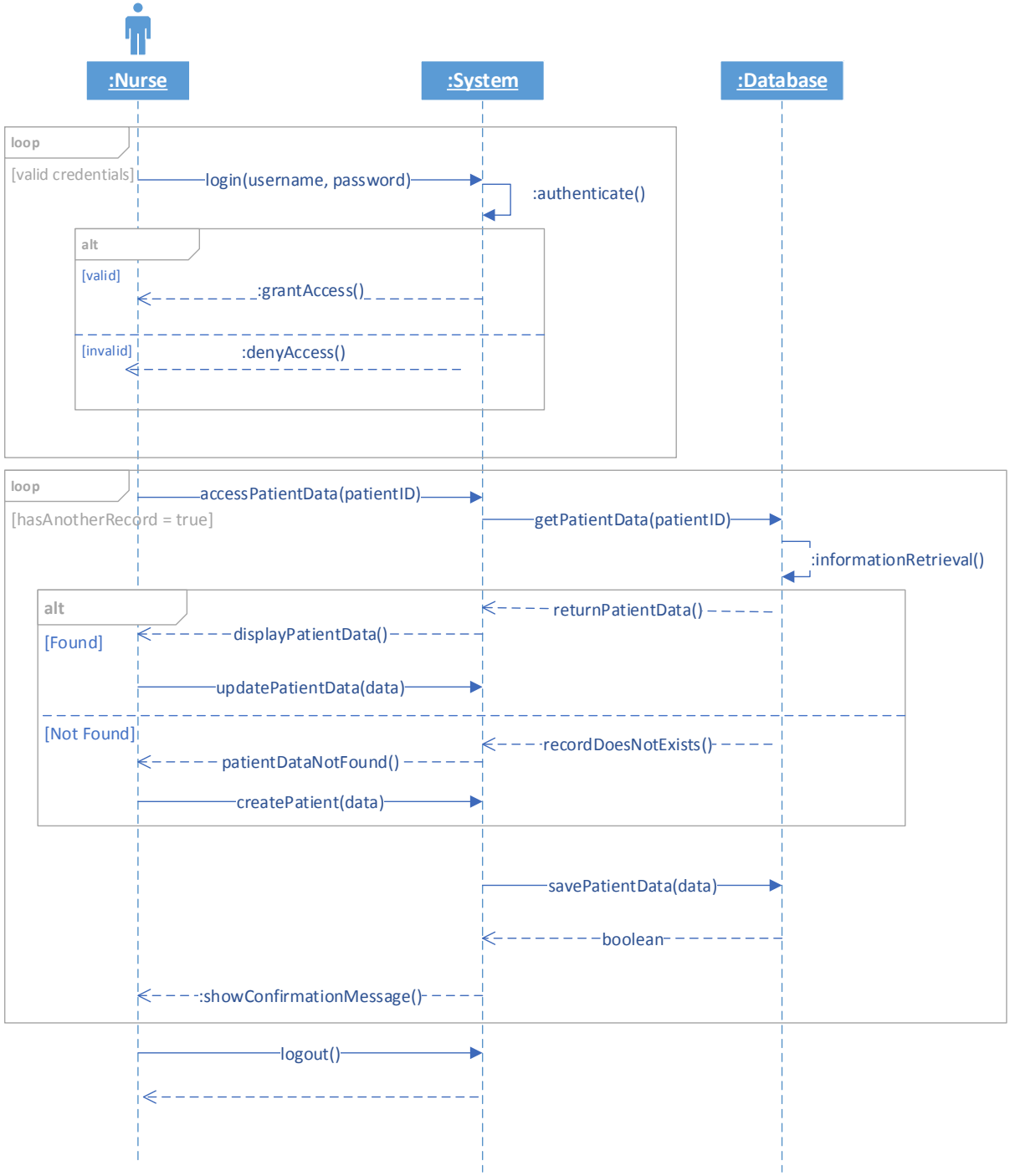

Figure 21: SSD for Record Patient Data Use Case

12.2 Diagnostic Assistance

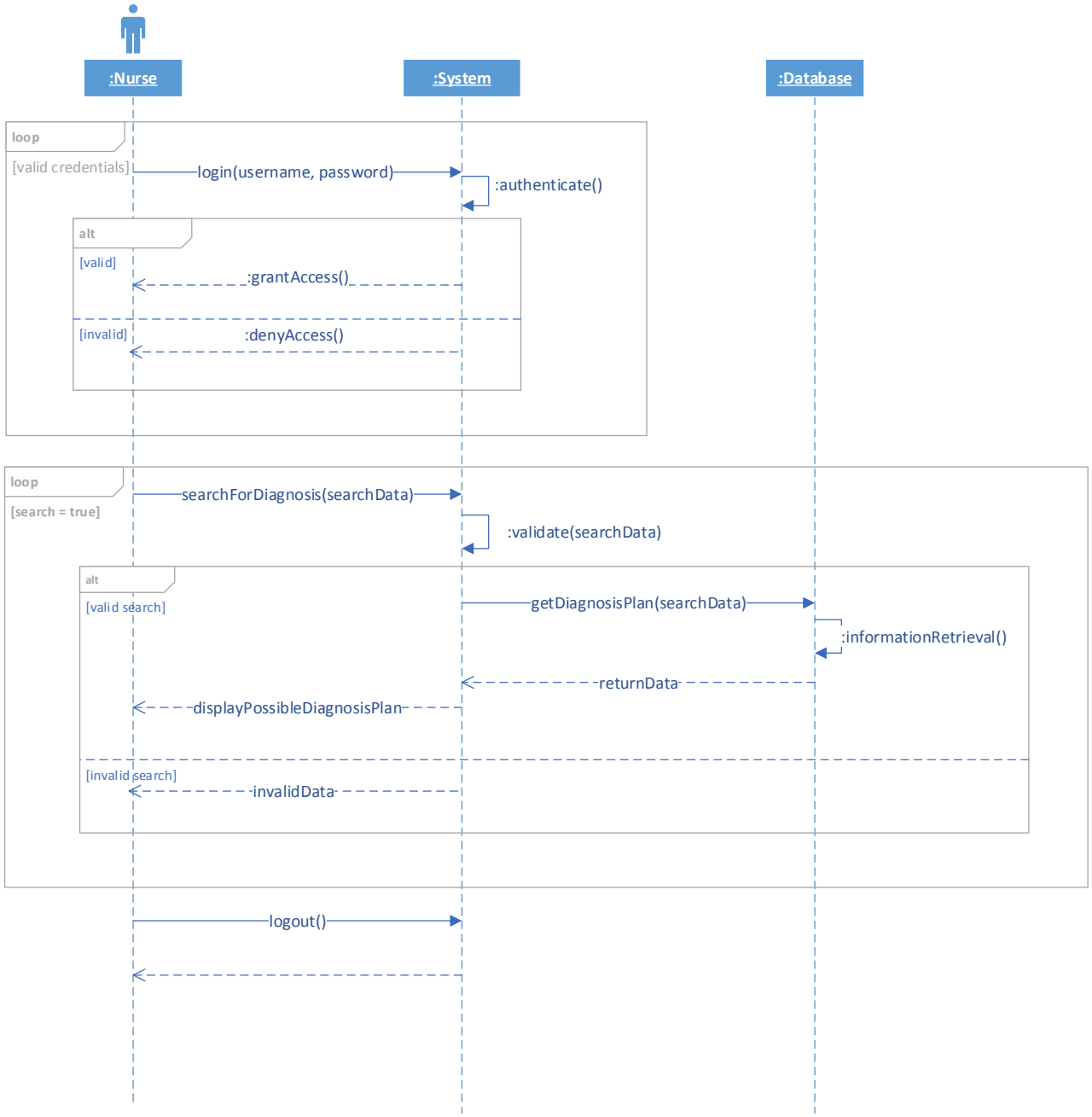

Figure 22: SSD for Diagnostic Assistance Use Case

12.3 Data Entry Assistance

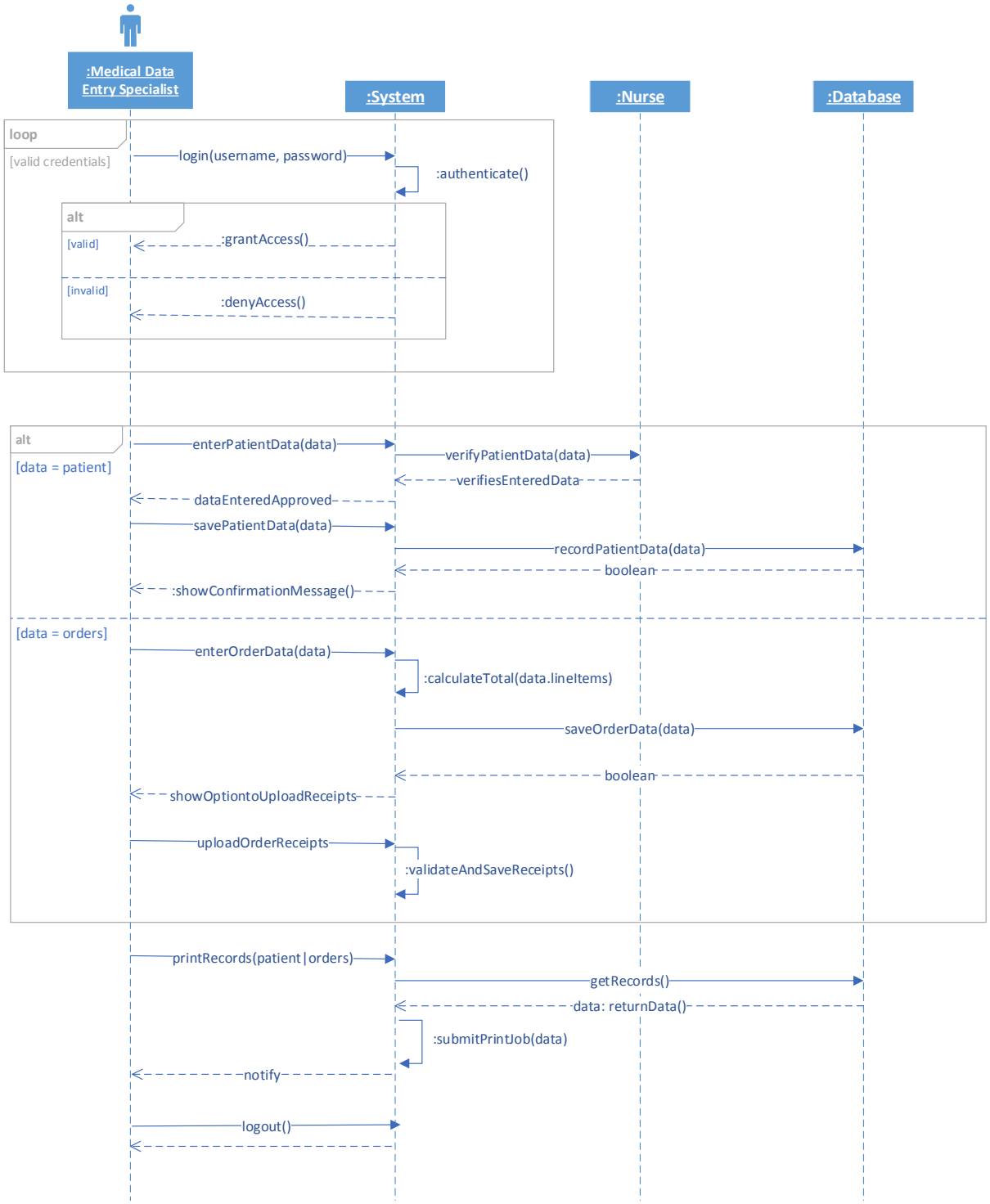

Figure 23: SSD for Data Entry Assistance Use Case

13. Activity Diagram

13.1 Record Patient Data

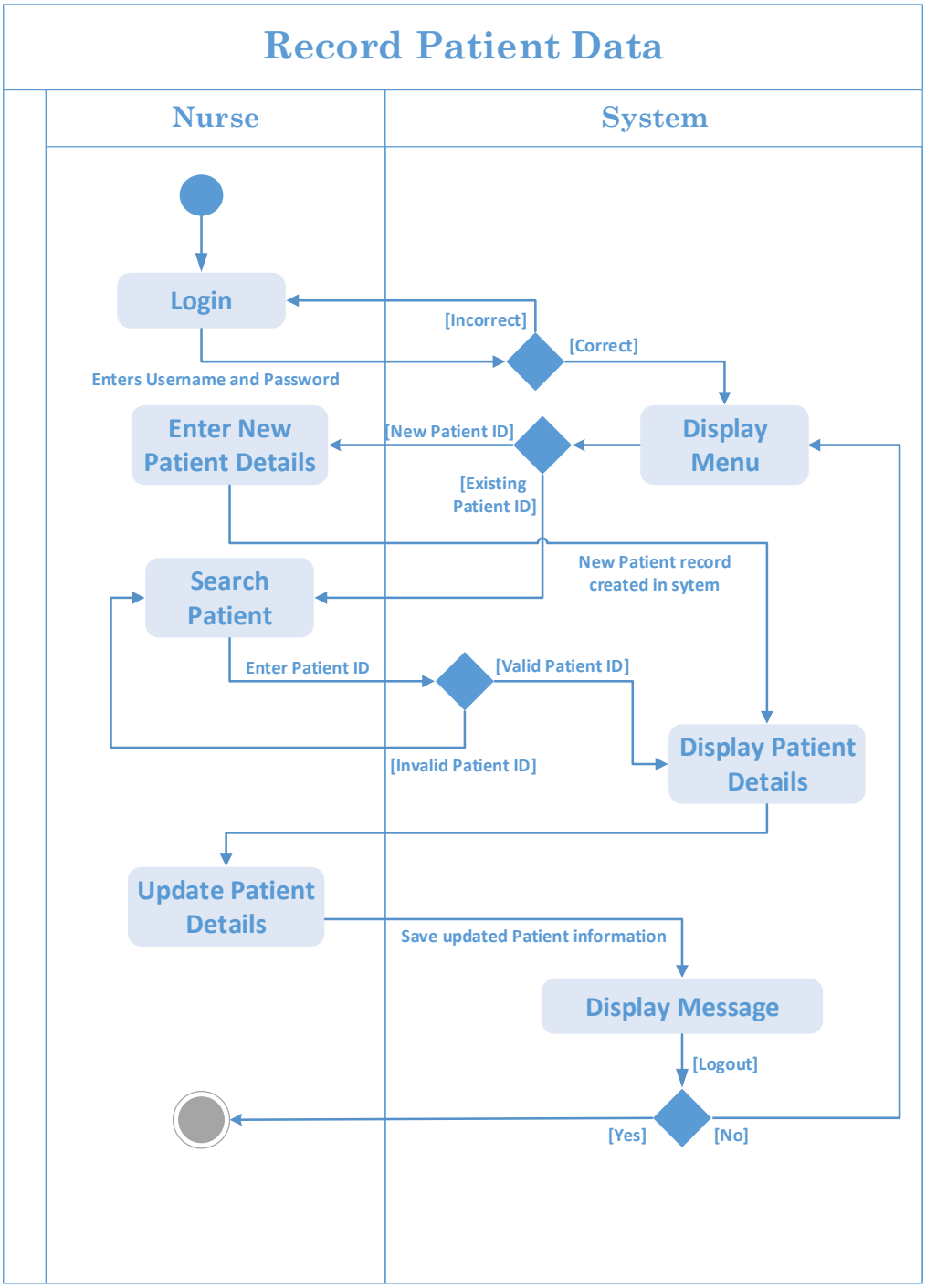

Figure 24: Activity Diagram for Record Patient Data Use Case

13.2 Diagnostic Assistance

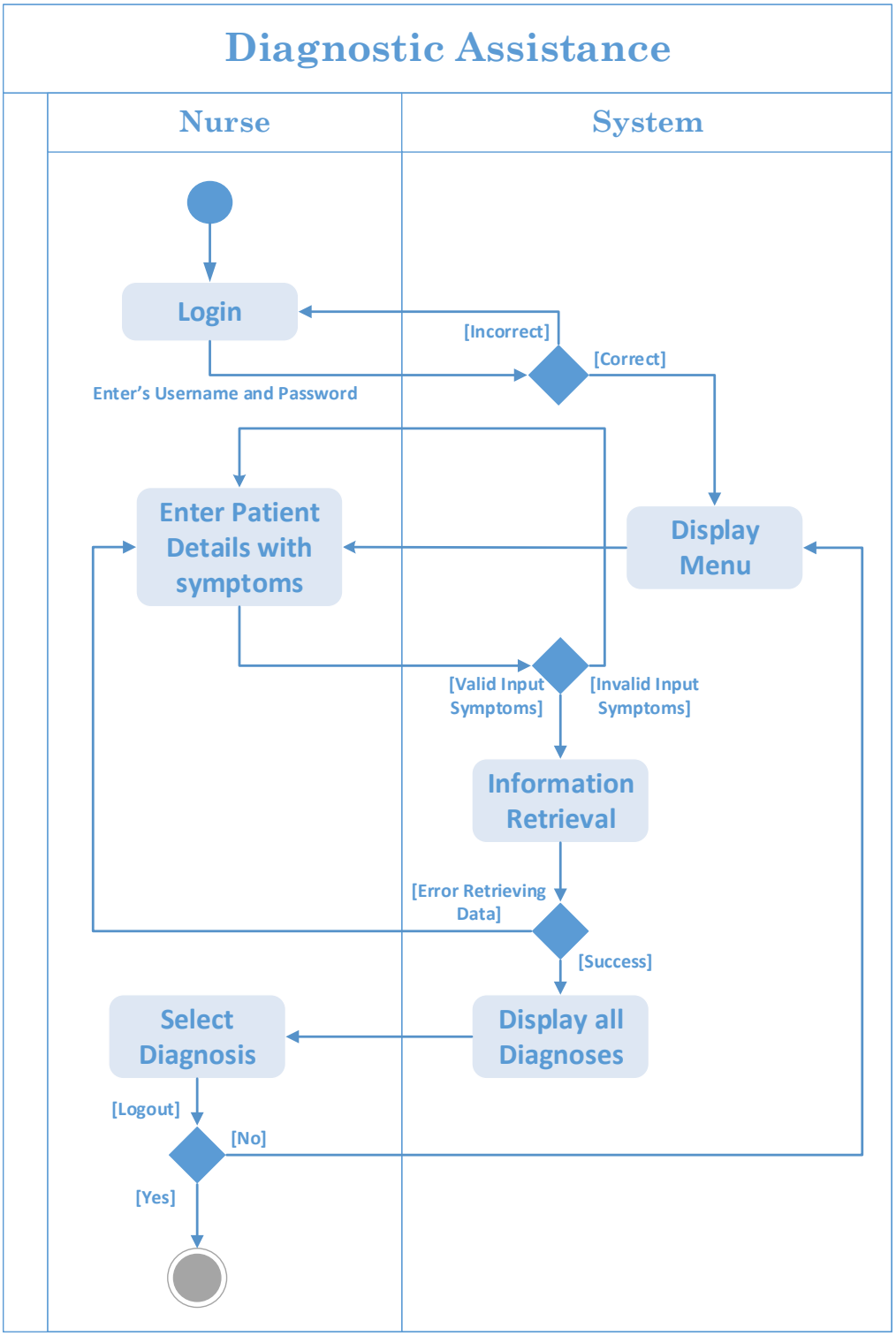

Figure 25: Activity Diagram for Diagnostic Assistance Use Case

13.3 Data Entry Assistance

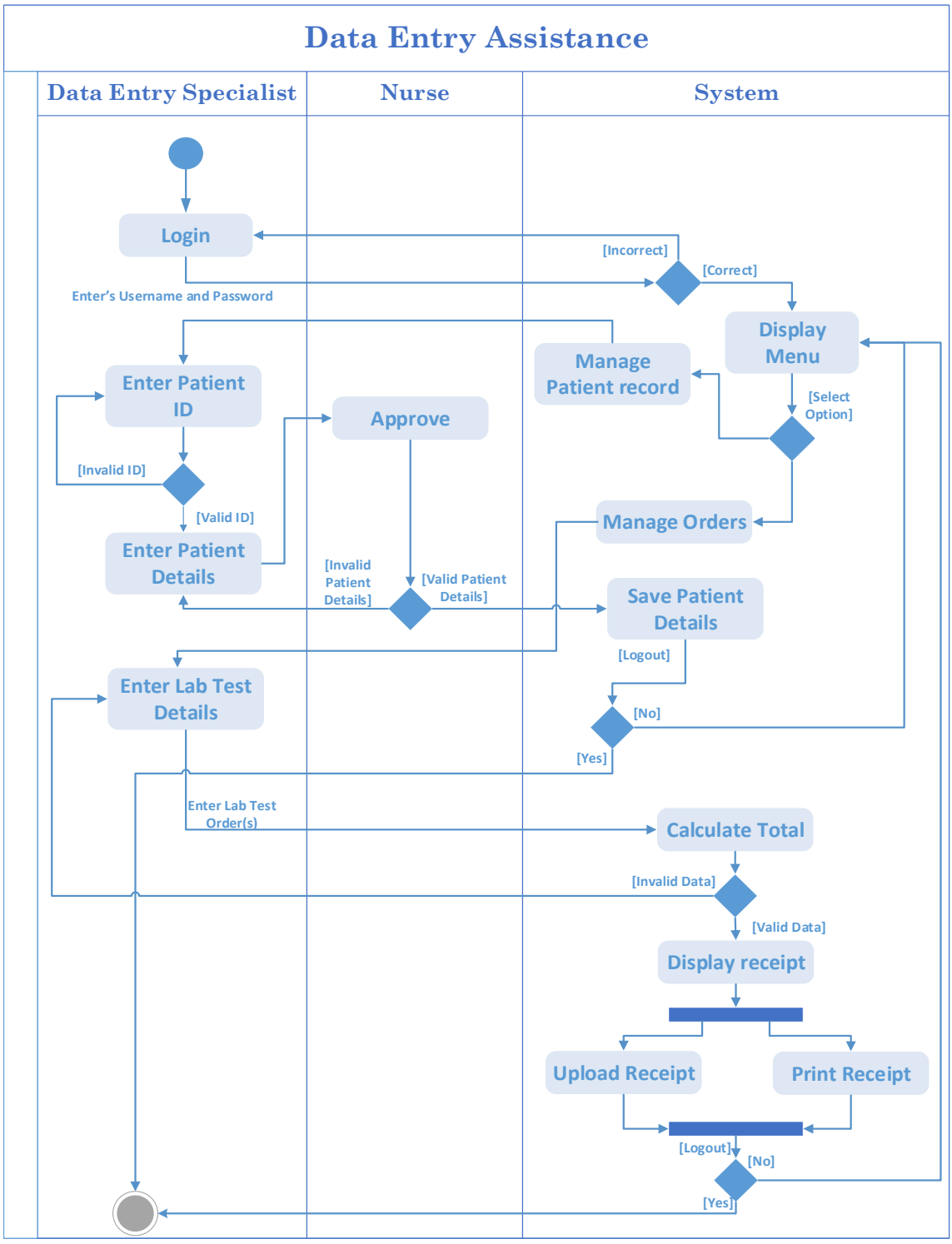

Figure 26: Activity Diagram for Data Entry Assistance Use Case

14. Test Cases

14.1 Test Cases for Record Patient Data

14.1.1 Scenario Matrix for Record Patient Data

Scenario	Originating Flow	Alternate Flow
Scenario 1 : Successful Diagnostic Assistance	Basic Flow	
Scenario 2 : Unidentified Nurse	Basic Flow	Alternate 1
Scenario 3 : Invalid Patient Data	Basic Flow	Alternate 2
Scenario 4: Failure to connect to Database	Basic Flow	Alternate 3
Scenario 5: Database updation fails	Basic Flow	Alternate 4
Scenario 7: Logout Failure	Basic Flow	Alternate 5

Source: Fully dressed use case: Record Patient Data

Basic Flow: Main Success Scenario

Alternative Flow 1: 2a

Alternative Flow 2: 3a

Alternative Flow 3: 4a

Alternative Flow 4: 7a

Alternative Flow 5: 10a

14.1.2 First Test Case for Diagnostic Assistance

<table>
<tr><td>Test Case ID</td><td>TC_RecordPatientData_1</td></tr>
<tr><td>Title</td><td>Test Case for Record Patient Data</td></tr>
<tr><td>Requirement</td><td>Main Scenario of Record Patient Data</td></tr>
<tr><td>Settings</td><td>Keyboard, Monitor and Mouse Connected to a computer</td></tr>
<tr><td>Preconditions</td><td>Nurse is authenticated in to the system</td></tr>
<tr><td>Post Conditions</td><td>The record is created or Updated</td></tr>
<tr><td>Description</td><td>The Wound Nurse enters the new patient information into the system</td></tr>
<tr><td>Flow</td><td>
<table>
<tr><td>Step</td><td>User(Wound Nurse)</td></tr>
<tr><td>10</td><td>Login[correct]</td></tr>
<tr><td>20</td><td></td></tr>
<tr><td>30</td><td>Enter patient details[new]

First Name = “Rajesh”
Last Name = “Koothrapalli”
Birthdate = “11-31-1992”
Gender = “Male”
Health Insurance Number = “888-334-222”
Address = “23,Second Avenue”
City=”Montreal”
ZIP=”H3H2C3”
Phone=”514-298-3968”
e-mail=”rajesh@gmail.com”
Patient Symptom1=”rashes”
Patient Symptom2=”Pain in the affected area”
Patient Allergy1=”Allergic to amoxicillin”</td></tr>
<tr><td>40</td><td></td></tr>
<tr><td>50</td><td>Update[save]</td></tr>
<tr><td>60</td><td></td></tr>
</table>
</td></tr>
<tr><td>Expected Results</td><td>The Patient Record is created with the specified patient attributes and should be searchable with the generated patient ID</td></tr>
</table>

14.1.3 Second Test Case for Record Patient Data

Test Case ID	TC_RecordPatientData_2
Title	Test Case for Record Patient Data
Requirement	Main Scenario of Record Patient Data – Existing Patient
Settings	Keyboard, Monitor and Mouse Connected to a computer
Preconditions	Nurse is authenticated in to the system Patient Record is already existing in the system
Post Conditions	The record is Updated
Description	The Wound Nurse enters patient information into the system.
Flow	Step: User(Wound Nurse) 10: Login[correct] 20: 30: Update patient details Patient Symptom1=”rashes” Patient Symptom2=”Pain in the affected area” Patient Allergy1=”Allergic to amoxicillin” 40: 50: Update[save] 60:
Expected Results	The Patient Record is updated with the specified patient attributes and should be searchable.

14.2 Test Cases for Diagnostic Assistance

14.2.1 Scenario Matrix for Diagnostic Assistance

Scenario	Originating Flow	Alternate Flow	Next Alternate Flow
Scenario 1 : Successful Diagnostic Assistance	Basic Flow		
Scenario 2 : Unidentified Nurse	Basic Flow	Alternate 1	
Scenario 3 : Invalid Search Data	Basic Flow	Alternate 2	
Scenario 4: Failure to connect to Database	Basic Flow	Alternate 3	
Scenario 5: Test Connection Fails	Basic Flow	Alternate 3	Alternate 6
Scenario 6: Session Timeout	Basic Flow	Alternate 4	
Scenario 7: Logout Failure	Basic Flow	Alternate 5	

Source: Fully dressed use case: Diagnostic Assistance

Basic Flow: Main success scenario

Alternative Flow 1: 2a

Alternative Flow 2: 5a

Alternative Flow 3: 6a

Alternative Flow 4: 6b

Alternative Flow 5: 10a

Alternative Flow 6: 6a/2a

14.2.2 First Test Case Diagnostic Assistance

Test Case ID	TC_DiagnosticAssistance_1
Title	Test Case for Diagnostic Assistance
Requirement	Main Scenario of Diagnostic Assistance
Settings	Keyboard, Monitor and Mouse Connected to a computer
Preconditions	Nurse is authenticated in to the system
Post Conditions	The system performs information retrieval based on the data entered by the nurse to devise a diagnosis
Description	The Wound Nurse enters the characteristics of the wound into the system
Flow	See table below
Expected Results	The system checks the validity of the data entered by the nurse and starts matching the data by comparing it to the data present in the database to devise an appropriate treatment plan

Step	User(Wound Nurse)
10	Login[correct]
20	
30	Enter Wound Details Classification = “Open” Contamination = “Infected” Type = “Laceration” Size = “Medium” Location = “Leg” Blood = “Yes” Patient Status =”Normal” Patient Symptom1 = ”Breathlessness” Patient Symptom2=”Pain in the affected area” Patient Allergy1=”Allergic to amoxicillin”
40	
50	Search and Retrieve appropriate treatment plan
60	

14.2.2 First Test Case Diagnostic Assistance

<table>
<tr><td>Test Case ID</td><td>TC_DiagnosticAssistance_2</td></tr>
<tr><td>Title</td><td>Test Case for Diagnostic Assistance</td></tr>
<tr><td>Requirement</td><td>Main Scenario of Diagnostic Assistance</td></tr>
<tr><td>Settings</td><td>Keyboard, Monitor and Mouse Connected to a computer</td></tr>
<tr><td>Preconditions</td><td>Nurse is authenticated in to the system</td></tr>
<tr><td>Post Conditions</td><td>A Diagnosis with a suggested treatment plan is displayed on the system</td></tr>
<tr><td>Description</td><td>A Diagnosis is performed by the system based on the parameters that have been entered in the wound detail form and a treatment plan is devised with suggested treatment plans ranked by rate of success</td></tr>
<tr><td>Flow</td><td>
<table>
<tr><td>Step</td><td>User(Wound Nurse)</td></tr>
<tr><td>10</td><td>Login[correct]</td></tr>
<tr><td>20</td><td>Search and Retrieve appropriate treatment plan</td></tr>
<tr><td>30</td><td>Diagnosis and Treatment Plan

Wound Type = “Pressure ulcer”
Wound Description = “*description*”
Contributing Factors = “*list of causes*”
Objective = “*goal of treatment plan*”
Wound Management = “*steps for treatment*”
Suggested Dressing = “Bacitracin”</td></tr>
<tr><td>40</td><td>Select Treatment Plan</td></tr>
<tr><td>50</td><td>Update[save]</td></tr>
<tr><td>60</td><td>Print Treatment Plan</td></tr>
</table>
</td></tr>
<tr><td>Expected Results</td><td>The most reliable diagnosis is displayed pertaining to the data entered by the nurse and is ranked based on matching previous data. An appropriate treatment plan is devised for managing and treating the wound</td></tr>
</table>

14.3 Test Cass for Data Entry Assistance

14.3.1 Scenario Matrix for Data Entry Assistance

Scenario	Originating Flow	Alternate Flow
Scenario 1 : Successful Data Entry	Basic Flow	
Scenario 2 : Unidentified Nurse	Basic Flow	Alternate 1
Scenario 3 : Invalid Patient Data	Basic Flow	Alternate 2
Scenario 5: Receipt Upload Fails - limited system space	Basic Flow	Alternate 3
Scenario 6: Wrong Bill Calculation by System	Basic Flow	Alternate 4
Scenario 7: Printer Connection Failure	Basic Flow	Alternate 5
Scenario 8: Logout Failure	Basic Flow	Alternate 6

Source: Fully Dressed Use Case: Data Entry Assistance

Basic Flow: Main Success Scenario

Alternative Flow 1: 2a

Alternative Flow 2: 3a

Alternative Flow 3: 6a

Alternative Flow 4: 7a

Alternative Flow 5: 9a

Alternative Flow 6: 11a

14.3.2 First Test Case Data Entry Assistance

Test Case ID	TC_DataEntryAssistance_1
Title	Test Case for Data Entry Assistance
Requirement	First scenario of Data Entry Assistance
Settings	Keyboard, Monitor and Mouse Connected to a computer
Preconditions	The data entry assistant is authenticated in to the system
Post Conditions	The data entry assistant is able to enter and modify patient details
Description	The secondary user, the data entry assistant's job is to enter and modify patient details w.r.t to the information given to him\her by the respective nurse
Flow	See table below
Expected Results	The Patient Record is modified with the specified patient attributes and should be searchable with the respective Patient ID

Step	User(Data Entry Assistance)
10	Login[correct]
20	
30	Modify Patient Data Patient ID: W9678800001 First Name = "Joseph" Last Name = "Tribbiani" Birthdate = "09-27-1982" Gender = "Male" Health Insurance Number = "976-642-245" Address = "1230, Unity Square" City ="Laval" ZIP ="H3P6Y9" Phone="438-532-7745" e-mail="joe_trib@gmail.com" Patient Symptom1="rashes" Patient Symptom2="Pain in the affected area" Patient Allergy1="Allergic to amoxicillin
40	
50	Update
60	

14.3.3 Second Test Case Data Entry Assistance

Test Case ID	TC_DataEntryAssistance_2
Title	Test Case for Data Entry Assistance
Requirement	First scenario of Data Entry Assistance
Settings	Keyboard, Monitor and Mouse Connected to a computer
Preconditions	The data entry assistant has correctly updated patient details
Post Conditions	The data entry assistant gets approval to save the modified patient details into the database
Description	The data entry assistant forwards the modified patient form and can only save it in the database with the approval of the respective nurse
Flow	See table below
Expected Results	The Patient Record is modified with the specified patient attributes and should be searchable with the respective Patient ID given nurses approval

Step	User(Data Entry Assistance, Nurse)
10	Forwards modified patient form and requests approval from designated nurse
20	
30	Nurse verifies modified form Patient ID: W9678800001 First Name = “Joseph” Last Name = “Tribbiani” Treatment Plan = “**suggested treatment plan**” Prescriptions = “**suggested prescriptions**”
40	
50	Approve
60	Data Entry Assistant Update [save]

14.3.4 Third Test Case Data Entry Assistance

<table>
<tr><td>Test Case ID</td><td>TC_DataEntryAssistance_3</td></tr>
<tr><td>Title</td><td>Test Case for Data Entry Assistance</td></tr>
<tr><td>Requirement</td><td>Second scenario of Data Entry Assistance</td></tr>
<tr><td>Settings</td><td>Keyboard, Monitor and Mouse Connected to a computer</td></tr>
<tr><td>Preconditions</td><td>The data entry assistant is authenticated in to the system</td></tr>
<tr><td>Post Conditions</td><td>The data entry assistant is able to enter and modify lab test details</td></tr>
<tr><td>Description</td><td>The secondary user, the data entry assistant’s job is to enter and modify lab test details w.r.t to the information given to him\her by the respective nurse</td></tr>
<tr><td>Flow</td><td>
<table>
<tr><td>Step</td><td>User(Data Entry Assistant)</td></tr>
<tr><td>10</td><td>Login[correct]</td></tr>
<tr><td>20</td><td></td></tr>
<tr><td>30</td><td>Enter Lab Test Data [new]

Test Type = “Blood Profile”
First Name = “Joseph”
Last Name = “Tribbiani”
Gender = “Male”
Blood Group = “O-ve”
Cholesterol = “Normal”
Triglycerides = “Normal”</td></tr>
<tr><td>40</td><td></td></tr>
<tr><td>50</td><td>Update[save]</td></tr>
<tr><td>60</td><td></td></tr>
</table>
</td></tr>
<tr><td>Expected Results</td><td>The Lab Test Record is created with the specified patient attributes and should be searchable with the generated Lab Test ID</td></tr>
</table>

14.3.5 Fourth Test Case Data Entry Assistance

<table>
<tr><td>Test Case ID</td><td>TC_DataEntryAssistance_4</td></tr>
<tr><td>Title</td><td>Test Case for Data Entry Assistance</td></tr>
<tr><td>Requirement</td><td>Second scenario of Data Entry Assistance</td></tr>
<tr><td>Settings</td><td>Keyboard, Monitor and Mouse Connected to a computer</td></tr>
<tr><td>Preconditions</td><td>The data entry assistant has entered valid lab test data</td></tr>
<tr><td>Post Conditions</td><td>The data entry assistant is able to calculate correct total and finally upload and print a receipt</td></tr>
<tr><td>Description</td><td>The data entry assistant calculates the total amount spent on a lab test, creates a receipt, uploads and takes a print of the receipt</td></tr>
<tr><td>Flow</td><td>
<table>
<tr><td>Step</td><td>User(Data Entry Assistance)</td></tr>
<tr><td>10</td><td>Login[correct]</td></tr>
<tr><td>20</td><td></td></tr>
<tr><td>30</td><td>Enter Lab Test Data [new]

Test Type = “Blood Profile”
First Name = “Joseph”
Last Name = “Tribbiani”
Gender = “Male”
Blood Group = “O-ve”
Item = “Altoprev”
Nos = “2”
Item Cost = “24$”
Total = “48$”
Final Total = “52$” (incl. taxes)</td></tr>
<tr><td>40</td><td></td></tr>
<tr><td>50</td><td>Update[save]</td></tr>
<tr><td>60</td><td></td></tr>
<tr><td>70</td><td>Upload Receipt</td></tr>
<tr><td>80</td><td></td></tr>
<tr><td>90</td><td>Print Receipt</td></tr>
</table>
</td></tr>
<tr><td>Expected Results</td><td>The total cost for a lab test is calculated. A final receipt is generated and is printed for reference. This receipt is uploaded to the database to maintain records.</td></tr>
</table>

15. Traceability Matrices

15.1 Traceability Matrix for User Needs vs Features

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11
N1										X	
N2	X	X	X	X		X	X	X	X		X
N3					X		X				X
N4						X		X			X
N5	X		X	X		X			X	X	
N6		X					X				X
N7					X		X				X
N8				X				X			

User Needs [N1-N8]:

N1: Issuing Alerts and Reminders

N2: Comfortable User Interface

N3: Diagnostic Assistance

N4: Data and Image Interpretation

N5: Data Entry Assistance

N6: Therapy Critiquing

N7: Prescription and formulating treatment plan

N8: Information Retrieval

Product Features [F1-F11]

F1: Comfortable User Interface

F2: Expert Consultation

F3: User Management

F4: Generating Reports

F5: Patient Examination

F6: Record Patient Data

F7: Maintaining Medical Diagnosis

F8: Access Patient Records

F9: Data Entry Assistance

F10: Issuing Alerts and Reminders

F11: Diagnostic Assistance

15.2 Traceability Matrix for Features Vs Use Cases

	UC1	UC2	UC3	UC4	UC5	UC6	UC7	UC8	UC9	UC10
F1		X	X	X	X		X	X	X	
F2	X			X		X				
F3									X	
F4		X		X				X		
F5	X		X	X		X	X			
F6		X					X			
F7		X			X		X	X		
F8			X							
F9		X		X			X			
F10										X
F11	X			X	X		X	X		

Use Cases [UC1 –UC10]:

UC1: Patient Examination

UC2: Record Patient Data

UC3: Access Patient Records

UC4: Diagnostic Assistance

UC5: Maintaining Medical Diagnosis

UC6: Expert Consultation

UC7: Data Entry Assistance

UC8: Generating Reports

UC9: User Management

UC10: Issuing Alerts and Reminders

15.3 Traceability Matrix for Features Vs Supplementary Specifications

	Functionality	Usability	Reliability	Performance	Supportability	Design Constraints	Interfaces
F1	X	X					X
F2	X	X					
F3	X						
F4	X						X
F5					X		
F6	X				X		X
F7	X		X	X			
F8	X						
F9	X		X			X	X
F10				X		X	
F11	X			X			

15.4 Scenario Matrices

15.4.1 Scenario Matrix for Record Patient Data

Scenario Number	Originating Flow	Alternate Flow	Next Alternate	Next Alternate
1	Login			
2	User Authentication	Invalid Login Credentials	Re-enter login Details	
3	Create New Patient Record	Check existing Patient Record	Invalid Patient Details	Re-enter valid Patient Details
4	Connect to Database	Failure to Connect	Re-connect to Database	
5	Enter Patient Details			
6	Save Patient Record			
7	Creation of New Patient Record	Updating existing Patient Record	Failure to Add\Update Patient Record	Backup Patient Record
8	Confirmation Message			
9	Logout			
10	Clear Session	Go back to Login		

15.4.2 Scenario Matrix for Diagnostic Assistance

Scenario Number	Originating Flow	Alternate Flow	Next Alternate	Next Alternate
1	Login			
2	User Authentication	Invalid Login Credentials	Re-enter login Details	
3	Click Diagnostic Assistance			
4	Display Diagnostic Assistance form			
5	Enter Wound Details	Invalid Wound Details	Re-enter Valid Wound Details	
6	Information Retrieval	Failure to Connect to Database	Re-connect to Database	Timeout Error
7	Generate all Possible Diagnoses			
8	Select Appropriate Diagnosis			
9	Logout			
10	Clear Session	Go back to Login		

15.4.3 Scenario Matrix for Data Entry Assistance

Scenario Number	Originating Flow	Alternate Flow	Next Alternate	Next Alternate
1	Login			
2	User Authentication	Invalid Login Credentials	Re-enter login Details	
3	Manage Patient Records	Invalid Patient Data	Re-enter Valid Patient Details	
4	Approval by Designated Nurse			
5	Save Patient Record	Unable to Upload\Save	Create new Virtual space	Upload\Save to new allocated space
6	Manage Lab-Test Orders	Unable to Upload\Save	Create new Virtual space	Upload\Save to new allocated space
7	Calculate Sub-total and Total amount	Unable to calculate result	Manually calculate total	
8	Display			

	Confirmation Message			
9	Print Report	Unable to print	Check for available printers nearby	Print job, if printer becomes available
10	Logout			
11	Clear Session	Go back to Login		

15.5 Traceability Matrix for Use Cases to Test Cases

Use Case ID	**Scenario Number**	**Test Case ID**
UC_RecordPatientData	1	TC_RecordPatientData_1
UC_RecordPatientData	3a	TC_RecordPatientData_2
UC_DiagnosticAssistance	1	TC_DiagnosticAssistance_1
UC_DiagnosticAssistance	7	TC_DiagnosticAssistance_2
UC_DataEntryAssistance	1	TC_DataEntryAssistance_1
UC_DataEntryAssistance	5	TC_DataEntryAssistance_2
UC_DataEntryAssistance	6	TC_DataEntryAssistance_3
UC_DataEntryAssistance	9	TC_DataEntryAssistance_4

16. Appendix

16.1 Interview

An interview was conducted with the two primary users of the system namely a nurse and a doctor to gain more understanding about the corresponding requirements that are needed to build the system. The answers to the questions are not written in the exact words said by each user but they have been written and summarised for the better understanding of the user. Only the first two questions of the interview have been sub divided into different users. The rest of the questions are summary of only the relevant information that was required to gain a thorough understanding of the requirements.

Part I: Establishing the customer or User Profile

Nurse

Name: X

Institute: ABC General Hospital

Industry: Healthcare

Job Title: Wound Therapy Nurse

Rank: Wound Nurse

Experience: 14 years

Doctor

Name: Y

Institute: ABC General Hospital

Industry: Healthcare

Job Title: M.D, Specializing in Dermatology

Rank: Doctor

Experience: 10 years

What are your key responsibilities?

Nurse

Key responsibilities include treating people with different kinds of wounds, mostly specializing in dealing with pressure ulcers, diagnosing different types of wounds, monitoring patient status and keeping records of patient's information.

Doctor

Specialize in preventing, diagnosing, and treating skin diseases and conditions. Examples of common conditions that they treat include acne, dandruff, and skin cancer.

Could you tell me a few details about the patients you deal with?

I deal with patients who mostly come for the treatment of wounds, and also with patients who are bed ridden due to prolonged treatments such as paralysis, or induced coma, etc. These patients generally develop pressure ulcers on their backs due to constant lying on the back.

Do you lend your services to anyone?

Yes, I lend my services to a neurosurgeon who deals with patients who are paralysed and spend prolonged times on the bed.

Could you tell me some more information about him?

Yes.

Name: Jeffrey Hall, MD, MSc, FRCS(C)

Job Title: Neurosurgeon and Assistant Professor of Neurology and Neurosurgery at McGill University's Montreal Neurological Institute and Hospital.

How is Success measured?

Success is measured by the ability to build a software system that could provide the following –

- Providing alerts and reminders automatically as part of the workflow
- Providing suggestions at the time and location the decisions are being made
- Providing actionable recommendations
- Computerizing the entire process

What are the problems that could interfere with Success?

- The system provides incorrect diagnosis to specific wounds
- The system is unable to issue alerts at patients improving/deteriorating conditions
- Improper interpretation of patient data such as X-rays and other various scans
- Inability to identify inconsistencies, errors and omissions in a specified treatment plan
- Incorrect prescription of dosages and medications
- Graphical user interface does not provide user friendly environment
- System fails to update newer symptoms, and diagnosis

What are the problems we might encounter while building the system?

The main challenge would be to provide a user friendly environment to the nurses who do not have a lot of experience with computers. The nurses should be able to learn to use the system quickly and interpret the system with ease. The other main challenge would be to correctly match the symptoms and features of the wound with the information present in the database to avoid improper diagnosis and incorrect prescription of medicine.

Part II: Assessing the problem

Could you give me information on the patients regarding their age, activity level, days of hospitalization, illness, the patient's questions and behavioural patterns and other relevant information?

We deal with patients of various age groups. Some patients are barely communicative, bed ridden and have been admitted several times because of the pressure ulcers. The other most common wound we deal with is an incision wound. Pain is the common problem that most of the patients have to deal with. These patients are usually communicative. Sometimes, it does become a problem to deal with enquiries from the patients and give a spontaneous response. A patient with a pressure wound is usually admitted for a day to a week depending on the severity. On the other hand, patients with incision wounds are released within a couple of hours.

You tell me pressure wounds and incision wounds are the most common wounds you deal with. Could you tell me the procedure you follow for diagnosis?

Pressure wounds usually happen on the back. We start by assessing a newly admitted patient by measuring the length, width and depth of the ulcer. We then identify the various wound characteristics such as granulation and exudates. Based on this information, we identify the stage of the wound and decide on what procedure to follow for the treatment of the wound. Then, in the absence of ready information we refer to guide books for the appropriate treatment.

How do you go about treating these wounds?

Once we confirm a diagnosis we perform the correct treatment. For example, consider a patient Mr X who is diagnosed with a stage II pressure ulcer. We then decide on the dressing agent to be used and apply it with the appropriate techniques with care. Next, we assess Mr X's risk of developing another pressure ulcer. We examine his skin for any sign of redness, moisture, etc., based on the Braden scale. We then note his risk of developing another pressure ulcer on his heels as he has to be repositioned on his bed several times a day to avoid this. Usually, a caretaker is assigned for patients with pressure ulcers for periodic monitoring of the patient and

to change his position. We create a patient brochure with all the relevant information regarding the patient which allows the caretaker to refer to it to take proper care of the patient.

Could you give me some more details about what kind of information is present in the brochure?

The brochure teaches the caretaker on how to take care of the ulcer after Mr X is discharged, what dressing agents to use, where to find them, and whom to contact in case of complications.

What is the most common problem you encounter while treating a wound?

Pain is the most common problem while performing treatment on wounds. Another annoying problem is that the patients are communicative and sometimes frustrate us for not being able to give an answer immediately.

Anything else you would like to add?

Sometimes it is a pain to keep asking the dermatologists for recommendations due to time conflicts, causing frustrations between nurses. I wish there was a unique readily available source to avoid inconsistencies.

Part III: Understanding the User Environment

Who are the users?

- Register Nurse
- Assistant Nurse
- Wound Nurse
- Doctor
- Medical Data Entry Assistant

What is their educational background?

The educational background of the system users could differ from:

Nurses

- Bachelor's Degree in Nursing (BSN)
- Associate Degree in Nursing (ADN)
- Diploma Program in a hospital

Doctors

- M.D in relevant fields

Medical Data Entry Specialist

- High School Diploma
- Associate Degree in Medical Administration

How good is their knowledge on computers?

Most nurses have smart phones with a good medical background and have completed their degrees from good universities so I guess it won't be much of a problem to operate an electronic guidance system. Some nurses might need training.

Are the nurses experienced with this type of application?

The nurses are not experienced with this type of application. They should refer to the user manual or get training to learn how to use it efficiently.

What are your expectations for usability of the product?

We expect that the system will be used for treating different wounds by providing prompt and accurate diagnosis in different contexts due to the fact that the existing systems in the market do not handle some of the medical issues that the current system does.

Anything else?

The system should be user friendly and provide an easy-to-use interactive graphical user interface. There should be a user manual available that explains in detail how to use the software and to exploit it to its maximum capacity.

What are your expectations for training time?

The system-to-be designed should not require enhanced computer skills. It should be easy to understand and training should not take a long time.

Part IV: Recap for understanding

You have told me:

- The routine of treating a patient includes checking the patient, changing the dressing, and updating the record.
- In some cases, the case needs to be referred to another wound nurse, doctor, or other specialist.
- Currently, different systems are used in the hospital to support various functions; however, those systems are not integrated, although the interface design of each system is generally welcome by nurses.
- Most nurses gain their wound care knowledge from their school and on-job training. They also seek for senior's opinions when needed.
- Information to aid in diagnosis of wound conditions and about wound care products are highly desirable.
- Two main types of wound faced by nurses are pressure ulcer and surgical wound.
- Patients sometimes do not cooperate in the treatment. They may mingle with wound dressing or refuse reposition arrangement.
- A Computerized system is needed.

- The system should be able to provide alerts and reminders automatically regarding the patient's condition.
- The system should be able to provide accurate diagnosis and prescriptions in a small amount of time.
- There should be provision for actionable recommendations.
- The other features of the system include the following –
    - Data & Image Interpretation – interpreting the results of lab tests and clinical images such as X-rays and various types of scans, and scanning images for potential abnormalities for human attention.
    - Data Entry Assistance – assisting in entering orders for medications and lab tests, and assisting in patient information data entry.
    - Therapy Critiquing– identifying inconsistencies, errors and omissions in a specified treatment plan.
    - Prescription & formulating treatment plan – suggesting medications and dosages, checking for drug interaction and contraindications such as allergy, formulating a personalized treatment plan for a patient.
    - Information retrieval – assisting in filtering relevant documents from a search engine or information database, assisting in formulating search queries, performing information extraction and question answering, constructing a user profile and carrying out personalized searches.
- A system is needed for referral for appropriate diagnosis in the absence or unavailability of seniors and other experienced wound nurses; or in plain words a system should be in place to request information without having the need to approach others.
- An automated system is required to reduce and take care of most of the paperwork.

- A system is required that can act as a comprehensive, illustrative guidebook of wound types, their characteristics, and their suitable dressing agents.
- A brochure generator is required which generates an automatic brochure that consists of patient details.
- A system that consists of answers to every possible question a patient might ask.
- The Braden scale and reference for assigning conditions to possible descriptions.

Part V: The Analyst's input on the Customer's Problem

Which, if any, problems are associated with: (list any needs or additional problems you think should concern the users of the system.)

The system holds a lot of information and countless possibilities regarding the different wounds and diagnoses. There are countless permutations and combinations involved for an appropriate diagnosis. There will be multiple options to choose from. The software will be unlike anything a nurse has ever used before and might be a little complex to understand easily.

Is this a real problem?

Yes, a patient's life and care are of the utmost importance in any hospital. The system should provide a 100% accurate diagnosis as to avoid complications to both the patient and the hospital. The system should not make the life of a wound nurse a lot tougher by providing incorrect information about the wound and the patient.

What are the reasons for this problem?

As said earlier, there might be multiple diagnoses for a specific wound. Ranking them on an order of priority will be a problem.

How do you currently solve the problem?

Well, we use our knowledge and assistance from our superiors and make the best judgement calls in case of a complicated situation with a patient.

How would you like to solve the problem?

I wish there was a system with an easy to understand interface which can give speedy and accurate diagnoses to the nurses.

How would you rank solving these problems in comparison to other you have mentioned?

I would say it is a good solution.

Part VI: Assessing your solution

What if you could list out the most common wounds you receive we receive at hospital and then list out all their appropriate diagnoses and rank them according to which would be more favourable to treat the wound?

Yes, it is the normal procedure to be followed, but we would need to look at different parameters such as the age of the patient, their allergies and existing medical conditions. It is not as easy as it sounds.

So it would be convenient if there would be a computerised solution which would provide the most appropriate diagnosis for the criterion you just told me?

Yes, that would be really convenient.

Part VII: Assessing the Opportunity

Who in your organization needs this system?

The system will mostly be utilised by the wound nurses in the hospital but it might also be used by our superiors and doctors from other departments of the hospital.

How would you value a successful solution?

A successful solution would benefit the entire hospital as well as the patients that come for treatment in the hospital. It would help in making the life of a wound nurse a lot simpler and keep the patients a lot happier. It could help science to progress and bring computer-simulated systems into healthcare.

Part VIII: Assessing the reliability, performance, and support needs

What are your expectations for reliability?

As mentioned earlier, the life, care and comfort of a patient is of the utmost importance. Therefore, the system should provide a 100% accurate diagnosis as to avoid complications to both the patient and the hospital.

What are your expectations for performance?

I would not know much about the technicality and the hardware that is being used to manufacture this system but as long as the system provides an accurate diagnosis in the least amount of time possible, it would be great.

What are your expectations for usability of the product?

The system should provide a simple, user friendly, easy to use interface such that any nurse within the healthcare sector around the world should clearly be able to interpret what exactly what is displayed in front of her. If possible, it would be really great if the software could be used in different countries and could provide its interface in many different languages.

Will you support the product or the others will support it?

Yes, I will support the product myself as long as I work for the healthcare industry. However, my colleagues who have just joined the healthcare industry and have a long future ahead of them will support the product and help you improve it.

Part IX: Other Requirements

Are there any legal, regulatory, or environmental requirements or other standards that must be supported?

I would not know of that. I would like you to talk to the personnel in the tech and legal department.

Can you think of any other requirements we should know about?

- The system should provide correct diagnosis to specific wounds
- The system should be able to issue alerts at patients improving/deteriorating conditions
- Proper interpretation of patient data such as X-rays and other various scans
- Ability to identify inconsistencies, errors and omissions in a specified treatment plan
- Accurate prescription of dosages and medications
- Graphical user interface should provide user friendly environment
- System should be able to update newer symptoms, and diagnosis

Part X: Wrap-up

Are there any other questions I should be asking you?

No, there is not.

If I need to ask follow-up questions, may I give you a call? Would you be willing to participate in a requirements review?

You either send me an email or simply stop by the hospital and ask for me.

Part XI: The Analyst's Summary

Features that need to be included in the system to provide assistance to healthcare professionals -

- Issuing Alerts and Reminders
- Diagnostic Assistance
- Data & Image Interpretation
- Data Entry Assistance
- Therapy Critiquing
- Prescription & formulating treatment plan
- Information retrieval

Benefits out of the system

- Improved patient safety
- Improved quality of care
- Improved efficiency in healthcare delivery

Success factors Identified

- Providing alerts and reminders automatically as part of the workflow
- Providing suggestions at the time and location the decisions are being made
- Providing actionable recommendations
- Computerizing the entire process

16.2 Glossary

List of Terms, Acronyms and Abbreviations

Term / Acronym / Abbreviation	Expansion / Description / Definition
System	The Clinical Decision Support System
User	An end user who interacts with the Soft-body system
CDSS	Clinical Decision Support System
Wound	An injury on the skin of a patient
Symptom	Anomalies observed in the patient with respect to the wound.
Prescription	An instruction written by a medical practitioner that authorizes a patient to be provided a medicine or treatment
Braden Scale	The purpose of the scale is to help health professionals, especially nurses, assess a patient's risk of developing a pressure ulcer
Brochure	A Sheet that holds all information that is relevant to a patient. Every patient has a unique brochure that holds patient details and treatments given to be done
Diagnosis	The process of attempting to determine or identify a possible disease or disorder
Wound Catalogue	A collection of all wounds and their respective symptoms
Pager	A device used by nurses to receive alerts
CUI	Comfortable User Interface

EC	Expert Consultation
UM	User Management
GR	Generating Reports
DA	Diagnostic Assistance
PE	Patient Examination
RPD	Record Patient Data
MMD	Maintaining Medical Diagnosis
APR	Access Patient Records
DEA	Data Entry Assistance
ISA	Issuing Alerts and Reminders
SRS	System Requirement Specification
UI	User Interface
UML	Unified Modelling Language
AHP	Analytic Hierarchy Process
LAN	Local Area Network
SSD	System Sequence Diagram
PDF	Portable Document Format
OS	Operating System
Windows	Microsoft's Operating System

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